Manual

Starflow Ultrasonic Doppler Instrument

With MicroLogger

Model 6526

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules in the U.S.A. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This equipment has been tested for compliance with European regulations as follows:

Application of Council Directive:
2004/108/EC

Standards to which Conformity is declared:
EN-61000-6-1:2001
EN-61000-4-2:1995
EN-61000-4-3:1995
EN-61000-4-4:1995
EN-61000-4-6:1996
ENV-50204:1995

Any changes or modifications to this equipment not expressly approved by the manufacturer Unidata Pty Ltd could void the user's authority to operate this equipment.

Revision History

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1.0 Introduction

The STARFLOW Ultrasonic Doppler Instrument is a unique combination of water velocity, depth and temperature instruments integrated with a solid state logger. It is the first of a new generation of intelligent flow measurement systems.

1.1 Overview

By using digital signal processing techniques, STARFLOW is able to perform in a wide range of environments. It is used to record flows in pipes, channels and small streams and operates in a wide range of water qualities from fresh streams to primary sewage channels.

STARFLOW is mounted on (or near to) the bottom of the stream/pipe/culvert and measures the velocity and depth of the water flowing above it.

STARFLOW combines water velocity, water depth and water temperature measurement with a powerful data logger. This enables a complete stream study to be undertaken with a single instrument.

STARFLOW systems have been tested in small streams and pipes, and the calibration has been verified in a tow tank. However, at the time of writing, there is little field experience with the use of acoustics in natural streams. Indications are that different channels have different characteristics and that acoustics can see velocity distributions that, if they are correct, may challenge some conventional ideas.

1.2 Typical Applications

The instrument is intended for economically recording flows in channels, culverts and pipes. It can also be used where existing techniques are unsuitable or too expensive.

It is particularly useful at sites where no stable stage/velocity relationship exists and where flows are affected by variable tailwater conditions, culvert entry blockages, pipe surcharging, other unstable flow conditions, or even reverse flows.

MODELS

5m depth range (Model 6526-51 STARFLOW Kit).

2m depth range (Model 6526-21 STARFLOW Kit).

1.3 System Components

Your STARFLOW system consists of:

Model 6526 STARFLOW Instrument and Data Logger (including 15m signal cable and weatherproof plug).

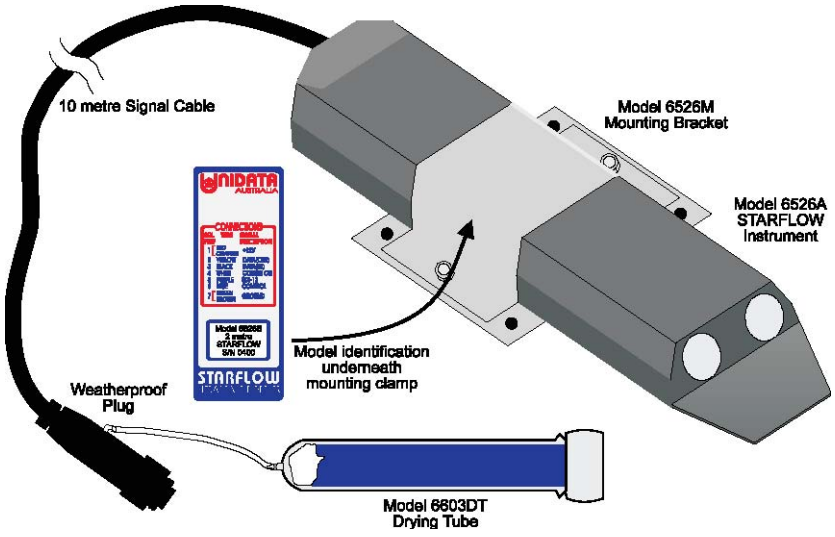
Model 6603DT «SQL» Drying Tube and Desiccant.

Model 6603D Adaptor cable for connecting the STARFLOW to a computer (9 pin RS-232) and battery.

Model 6526M Stainless Steel Mounting Bracket.

STARFLOW User's Manual (Manual 6241). This manual.

STARFLOW Support Software (Model 6301A0).



1.3.1 Accessories

The following accessories should be purchased according to your application requirements.

Model	Description
Model 6907C	12V, 12Ah Sealed Lead Acid Battery
Model 6904C	(7W) Solar Recharge Panel & Mount
Model 6904D	(12W) Solar Recharge Panel & Mount
Model 6701E	Weatherproof Enclosure with Frame
Model 6603A/5 or /10	«SQL» 5 or 10 metre Extension Cable
Model 6603V/10 or /20	«SQL» 10 metre or 20 metre Vented Extension Cable
Model 6705	Expanding Band Kit

1.4 Getting Started

To use STARFLOW, follow these steps:

1 Install the STARFLOW Support Software onto your PC compatible computer

2 Create a scheme (STARFLOW Program) for the measurement project

3 Install the STARFLOW instrument on site.

4 Load (Initialise) the STARFLOW instrument with a scheme.

And, some time later...

5 Unload (retrieve) the recorded data from the STARFLOW instrument and process the results.

6 Refer to the relevant sections of this manual for details and review the comprehensive Installation Checklist to make certain you have taken all the necessary steps.

2.0 Operating Principles

The STARFLOW measures velocity, depth and temperature each scan interval (15 to 600 seconds) and logs data according to your specification in the scheme. The measured data are logged and then scaled and processed during presentation and processing.

2.1 Micrologger

The STARFLOW contains a 128K data logger which controls the instrument's operation and logs the measurements.

Water Velocity in the vicinity of the STARFLOW is measured acoustically by recording the Doppler shift from particles and microscopic air bubbles carried in the water.

Water Depth above the STARFLOW is measured by a pressure transducer recording the hydrostatic pressure of water above the instrument.

Temperature is measured to refine the acoustic recordings. These are related to the speed of sound in water, which is significantly affected by temperature.

Battery Voltage is measured to allow the STARFLOW to stop operating if the supply voltage is below defined limits.

Flow, flow rate and total flow values are computed by STARFLOW from user defined channel dimension information (see Flow Measurement Extensions on page 109). Alternatively, the flow rate may be computed from the refined logged data using PC based computation of area x mean from each logged point. Total flows are then accumulated as rate x time.

2.2 Micrologger Operation

The MicroLogger switches on the STARFLOW instrument once per scan. The scan rate is specified by the user (see Using the Scheme Editor on page 66). Each time the STARFLOW switches on, it performs the following tasks:

Measurement – Each scan interval (user adjustable from 15 seconds to 10 minutes) the MicroLogger switches the STARFLOW on. It then measures velocity, depth and temperature (see below). These signals are stored in the MicroLogger memory.

Analysis – The MicroLogger then performs data processing and analysis defined in the scheme you have loaded (see Creating a New Scheme on page 69). This includes averaging, maximum/minimum and totalizing calculations. Flow computation is also performed at this time.

Communications – If a computer is connected to the STARFLOW instrument, the MicroLogger establishes communications via the RS-232 channel. An SDI-12 interrogation sequence will also be initialised at this time. Note: RS-232 and SDI-12 communications will occur simultaneously with other operations.

Data Logging – When the scan occurs at a log interval (from 15 seconds to 1 week) the MicroLogger records user defined measurement values (velocity, depth, flow, etc) into its memory (log buffer). Here, the data remains until the STARFLOW is unloaded into a computer.

2.3 How STARFLOW Measures Velocity

When sound is reflected from a moving target the frequency of the sound is varied by the velocity of the target. This variation is known as a Doppler shift. To measure water velocity in open channels STARFLOW exploits the particles moving with the water as acoustic targets (or scatterers) from an instrument fixed to the bed or bank.

There are two distinct types of doppler instruments that can be used to measure water velocity:

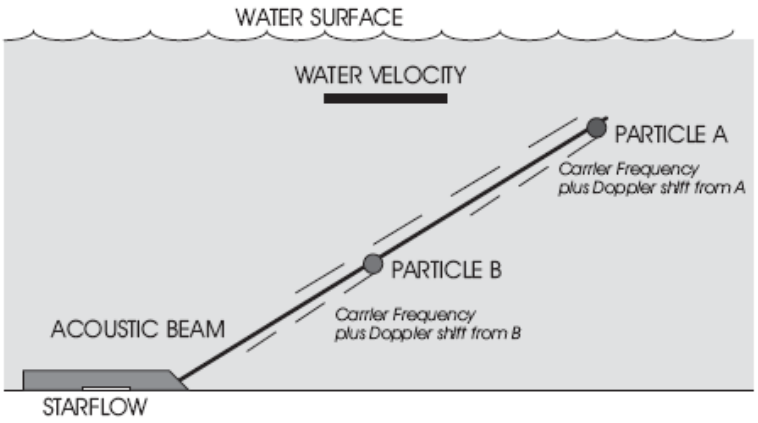
- Coherent (or profiling) dopplers transmit encoded pulses with the carrier frequency at target locations, and only measure signals reflected from these targets. This allows the velocity in a stream to be profiled. These instruments are complex and expensive.
- Incoherent (or continuous) dopplers like the STARFLOW, emit a continuous signal and measure any signals returning from scatterers anywhere and everywhere along the beam. These are resolved to a mean velocity that can be related to a channel velocity at suitable sites.

During a measurement cycle, ultrasonic sound is transmitted continuously at a fixed frequency, called a carrier. A receiver listens for reflected signals from any targets. A measuring circuit detects any frequency changes. A processing system accumulates and analyses these frequency changes and calculates a representative Doppler shift from the range received.

Each Doppler shift is directly related to the water velocity component along the beam. This is a physical relationship and if you know the speed of sound in water you can calculate the velocity of the reflector and thereby the velocity of the surrounding

water. STARFLOW instruments do not need calibration for velocity measurement.

The velocity measured is the component along the beam. Because the beam is at an angle to the flow, the Velocity is adjusted by the angle cosine.



2.4 Speed of Sound In Water

Velocity measurements are directly related to the speed of sound in water. The factor used to scale STARFLOW Velocity measurement is based on the speed of sound in fresh water at 20°C (see table below). This velocity of sound gives a calibration factor of 0.550mm/sec per Hz of Doppler shift.

This calibration factor may be adjusted for other conditions (see the appendix STARFLOW Configuration Settings on page 151). For example, the calibration factor for sea water is 0.5618mm/sec/Hz.

The speed of sound varies significantly with water density. Water density is dependent on pressure, water temperature, salinity and sediment content. Of these, temperature has the most significant effect and it is measured by the STARFLOW and applied in the correction of velocity measurements.

The STARFLOW corrects for the variation of the speed of sound in water due to temperature using a factor of 0.00138mm/s/Hz/°C. This correction is a best fit for water temperatures between 0°C to 30°C.

The following table shows how the speed of sound varies with temperature and between fresh and sea water.

VELOCITY OF SOUND IN WATER (m/s) AT ATMOSPHERIC PRESSURE		
TEMPERATURE (°C)	"FRESH WATER"	"SEA WATER"
0	1402	1449
5	1426	1471
10	1447	1490
15	1466	1507
20	1482	1521
25	1497	1534
30	1509	1545
35	1520	1555

Bubbles in the water are desirable as scatterers, but too many can affect the speed of sound. In air the speed of sound is about 350 m/s.

2.5 Site Considerations

The Doppler signal received, and the accuracy of the computed velocity, is related to the flow and cross-section characteristics of the site. A suitable site has the following features:

Feature	Description
Flows are laminar and the velocity measured by the transducer can be related to the mean velocity of the channel.	Velocity is measured from a limited path in front of and above the acoustic sensors. This area varies with the amount of suspended material in the water and the channel characteristics. The user has to determine the relationship between the measured and mean velocity.
The channel cross section is stable.	The relationship between water level and the cross-sectional area is used as part of the flow computation.
Velocities are greater than 20 mm / second.	The transducer does not process velocities slower than this. The maximum velocity is 5 metres / second. The transducer will measure velocities in both directions.
Reflectors are present in the water.	Generally the more material in the water the better. STARFLOW generally works well in clean natural streams but problems may be encountered in extremely clean water.
No excessive aeration.	Bubbles are good scatterers and occasional small bubbles will enhance the signal. However the speed of sound can be affected if there are excessive amounts of air entrapped in the flow.
The bed is stable and STARFLOW will not be buried by deposits.	Some coating and partial burying has little effect on the measured velocity but it should be avoided.

Other site considerations relate to the physical suitability for installation and operation of the instruments.

Safe working environment - particularly if you are measuring wastewater pipes or in confined locations.

Access is possible - to obtain check readings of depth and velocity at the transducer location, to verify the data produced.

Secure installation - resistant to vandalism and as inconspicuous as possible.

2.6 Factors Affecting Data Accuracy

STARFLOW measures velocity to an accuracy of ±2% and depth to ±0.25% of calibrated range. This is logged to a resolution of 1 mm/sec and 1mm respectively. The transducers have been calibrated and are expected to be stable for long periods provided they are not physically damaged, blocked or buried.

The purpose of the STARFLOW system is to produce FLOW DATA. This is the product of the cross section (derived from measured depth) and velocity data, each of which are modified by user defined factors before use. There are many opportunities for errors to accrue in the process and degrade the result. These can be reduced or eliminated by using the instrument properly. Some of the more significant potential error sources follow.

2.6.1 Alignment with Flow

For the calibration to be valid, the transducer needs to be horizontally and vertically aligned with the flow. While STARFLOWs are calibrated pointing into the flow, they can be pointed downstream with little loss of calibration accuracy. You may want tot do this when fouling of the sensor face is a problem.

Any angled flow in the horizontal plane will reduce the recorded velocity. A 10 degree angle will reduce the velocity recorded by 1.5%.

More significant errors will result from angled flow in the vertical plane. The sensors are manufactured to project acoustic signals at 30° above horizontal when the sensor is mounted horizontally. A 10° vertical flow angle change will cause errors of approximately +8.5% (@20°) and –11.5% (@40°).

2.6.2 Instantaneous Versus "Averaged" Velocity

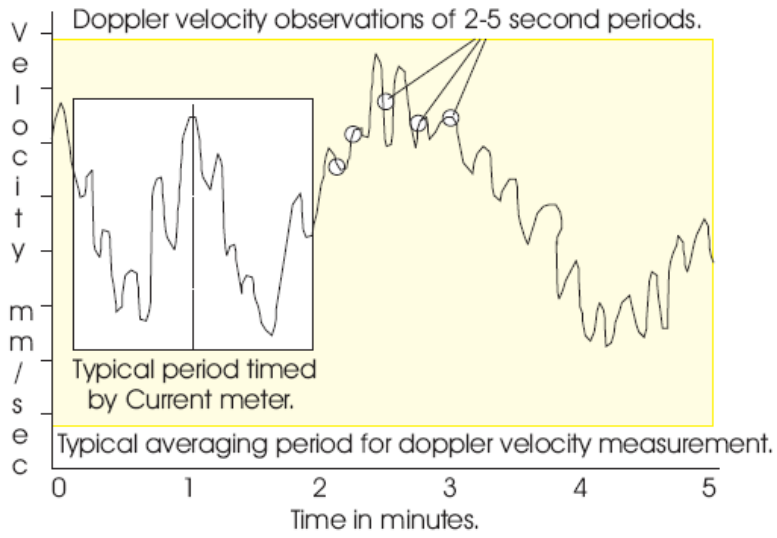
When you observe STARFLOW velocities, they will be seen to vary by 10% or more from scan to scan at some sites. Because STARFLOW is very sensitive to variations in velocities, you are able to see the natural velocity changes in the channel.

Although the discharge in a channel may be reasonably constant for a period of time, the velocity distribution is always changing. Different velocity streams wander from side to side and bed to surface as they progress down the channel. Turbulent swirls and eddies are carried downstream for long distances while they slowly decay.

Hydrographers will be used to having this action partly removed by the mechanical inertia of a current meter and the period over which a typical measurement is timed. However all will have noticed that the rate of revolutions of the current meter varies during the timing period.

Continual velocity logging at one location with a STARFLOW will show these cyclic velocity pulsations. The characteristics will be different for different sites and will vary with discharge.

Cycles will typically include short period fluctuations (a few seconds) overlaid on longer cyclic fluctuations (up to many minutes). Longer term pulsations may also be seen particularly in larger streams when in flood.



When comparing STARFLOW velocity and mechanical current meter readings, the display should be observed long enough to estimate the mean of the readings. This should be adopted as the logged velocity to compare with any check measurements.

When measuring velocity data STARFLOW samples for several seconds during each 1 minute scan. It is recommended that all velocity measurements are averaged over the log interval. This attenuates short frequency variations.

2.6.3 Conversion of Logged to Mean Velocity

The logged velocity data may have to be adjusted during post processing to reflect a mean velocity for the channel. The factors used will be site specific and have to be determined by the operator. This is done by obtaining a mean channel velocity by conventional techniques and comparing it with the average logged velocity. If necessary this process should be repeated at various discharges.

Where the relationship is complex or unstable, the accuracy of this method is compromised.

In laminar flow conditions the channel mean velocity could be expected to be between 90% and 110% of the logged velocity.

In small channels (say a 500mm diameter pipe) the factor may be close to 100% as a representative area of flow will have been “seen” by STARFLOW and contributed to the logged velocity.

In larger channels only the area adjacent to STARFLOW will be “seen” and the relationship will depend on how this portion relates to the vertical and horizontal velocity distribution in the channel. An instrument located in the centre of the stream would normally be in a higher velocity area. However in a deep channel STARFLOW may only see the slower portion of the velocity profile.

2.7 Depth Measurement

Water depth is measured using a solid state pressure sensor mounted underneath the STARFLOW and vented to atmospheric pressure via a vent tube inside the signal cable.

Water pressure is sensed via a pressure damping manifold which has been designed to sense depth in front of the velocity transducer.

The shape of the sensing manifold is designed to reduce velocity effects on the pressure sensor. These effects are significant at velocities above 2m/sec.

The vent tube is opened to the atmosphere through the signal cable connector and a vent tube desiccant cannister is fitted to ensure moisture does not enter the vent tube.

2.8 Flow Rate Calculations

Most users will record velocity and depth for later analysis. However, STARFLOW does have the capability of performing Flow Rate and Total Flow computations.

From these computed channels you may display and record Flow Rate and Totalised Flow (volumes).

2.9 A Quick Guide to STARFLOW Field Practice

These examples are provided to give you an idea of how to define a Scheme which meets site and operations requirements.

Site Interrogated Using Remote Telemetry

You intend to interrogate STARFLOW using a modem (remote telemetry). In this case:

Use Circular Log Buffer in the scheme.

Perform an Incremental Unload. If STARFLOW had a full log buffer, it would take a long time to unload a process that may be costly. You can shorten the time by performing an Incremental Unload, so only data logged since the last unload is retrieved.

The STARFLOW continues to store the most recent data even if the log buffer has been filled. It simply writes the new data over the earliest data stored.

2.9.1 Site Visited At Regular Intervals

You intend to visit the site regularly, unload the full buffer, then Program STARFLOW again as you leave. The STARFLOW software will calculate how long you can wait between visits so that data from the site will not be lost. In this instance:

Select Linear Buffer in the scheme.

Perform a Full Unload when you visit the site. You must plan to visit the site before the data buffer is full, otherwise, you'll lose the most recent data. After each unload, you must re-program STARFLOW before you leave the site. Re-programming STARFLOW resets the scheme to begin logging and the start of memory.

If, instead, you choose to use a circular data buffer and the log buffer becomes full, the most recent data collected overwrites the earliest stored data. Whereas once a linear buffer is full, the most recent data will not be stored.

Time Clock Considerations – The STARFLOW's time clock is automatically set to your computer's time whenever you program the STARFLOW. During normal operation, the STARFLOW time clock may slowly lose or gain time. Over a long period, this may accumulate into a significant time error especially if you use Incremental Unloads and never re-Program the STARFLOW in normal use. To correct a time clock error, simply re-Program the STARFLOW (remembering to Unload any logged data first. If you are

using a linear buffer and programming the STARFLOW after every unload, you will not have accumulated time errors.

3.0 Specifications

Mechanical

Size:	290mm x 70mm x 25mm (LxWxH)
Weight:	850g (2kg with 15m cable)
Material:	PVC body. Stainless steel mounting plate.
Cable:	15 metre, 9 way vented cable «SQL» Compatible

MicroLogger

Storage Memory:	100kbyte, CMOS RAM
Log Interval:	Programmable: 5 seconds to 1 week
Communication:	RS-232, 300–38400 baud
SDI-12:	1200 baud, instrument channel
Flow computation:	Flow Rate, Totalised Flow
Control:	CMOS output trigger
Operating Temperature:	0°C to 60°C water temperature
Compatibility:	STARLOG compatible

Velocity

Range:	21mm/s to 4500mm/s bidirectional
Resolution:	1mm/s
Accuracy:	2% of measured velocity
Signal Path:	30° above horizontal

Depth

Ranges:	Model 6526-21 0 to 2m
	Model 6526-51 0 to 5m
Resolution:	Model 6526-21 0 to 1m – 1mm
	1 to 2m – 2mm
	Model 6526-51 0 to 2.5m – 2.5mm
	2.5 to 5m – 5mm
Accuracy:	±0.25% of calibrated lower range
Type:	Hydrostatic pressure sensor vented to atmosphere.

Temperature

Range:	-17°C to 60°C
Resolution:	0.1°C

Power

Battery:	External 12VDC
Voltage:	11.5V to 15VDC
Current:	50_A standby, 90mA during communication
	200mA during measurement
Average Power:	0.3W (1 min scan rate)

3.1 Factory Settings

Scan Rate: 1 minute

Log Interval: 15 minutes

Max. Sampling Dur: 2 seconds

Maximum Samples: 200

Quartile: 100%

3.2 Battery Duration Table

12V Battery	Scan Rate		
Capacity	5 min	1 min*	15 sec
7Ah	218 days	43 days	11 days
12Ah	375 days	74 days	19 days

*Factory setting.

Due allowance must be made for interrogation by computer/modem.

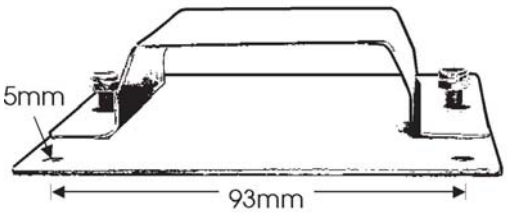
3.3 Memory Duration Table

Number of Parameters Recorded	Log Interval	
	15 min*	10 min
Velocity & Depth (2)	300 days	250 days
Velocity, Depth & Temperature (3)	200 days	160 days
Velocity, Depth, Temperature & Battery (4)	150 days	125 days

*Factory setting.

4.0 Installation

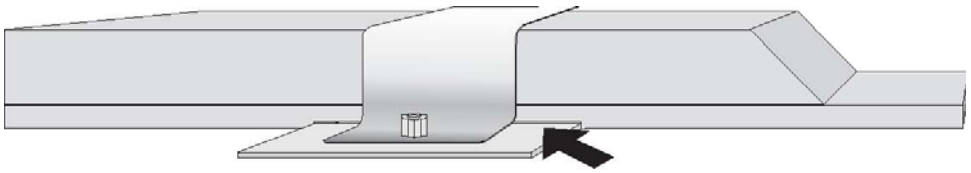
STARFLOW is a very effective alternative to conventional flow measuring installations for small streams. STARFLOW is unobtrusive and ideally suited to flow conditions in culverts, channels and drains. Cost, maintenance and environmental impact of new installations is minimized by avoiding the construction of conventional flow measuring structures.



4.1 STARFLOW Mounting

A versatile mounting clamp is available to secure a STARFLOW Instrument into a channel or a pipe. Loosening the Nylock nuts enables the instrument to be removed for inspection. The bracket saddle locks the instrument into its correct position and alignment.

Before Tightening Mounting Bracket …

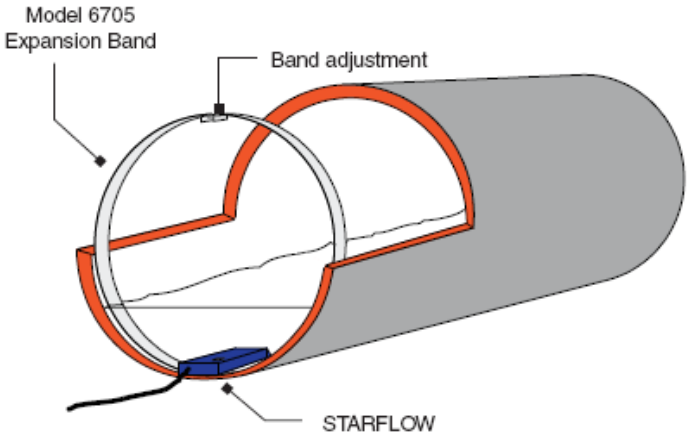


check there is no debris between it and the STARFLOW unit.

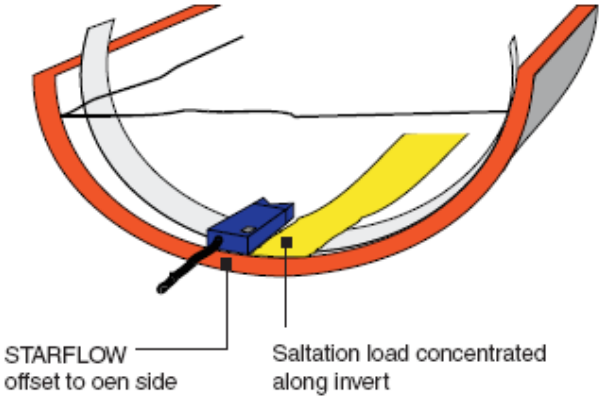
Do not overtighten !

4.2 Locating The Starflow

A typical installation is in a pipe or culvert with diameters between 300 and 2000 mm. The STARFLOW should be located near the downstream end of a straight and clean culvert, where non-turbulent flow conditions are maximised. The mounting should ensure the unit sits right on the bottom to avoid debris catching beneath it.

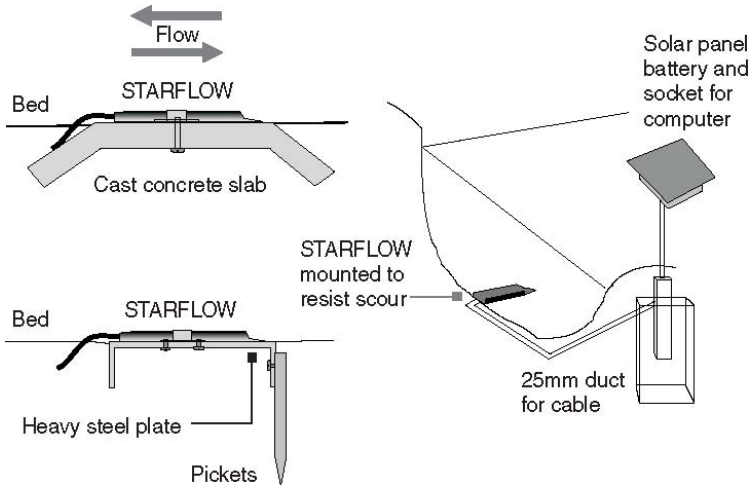


In culverts the sensor can be mounted on a stainless steel band that is slipped inside the pipe and expanded to lock it in position. In open channels special mounting brackets may be required. Special protection from vandalism and interference may also be required.



The sensor can be located at the invert of the pipe but may be better located slightly to one side of the invert to avoid alluvial material or heavy debris transported during higher flows. It will not be affected by being located partly up the side of a pipe provided it remains aligned with the flow. For details of installing the STARFLOW in a pipe using the Model 6705 Expanding Band Kit see the Appendix on page 163.

The sensor can also be located in the bed of a natural or artificial channel. Again it should be installed and located in such a way as to avoid accumulating debris, being buried by alluvial material or getting washed away. The cable should be protected from damage.



4.3 STARFLOW Pointing Upstream or Downstream?

STARFLOW can be pointed either upstream or downstream, depending on which would produces more accurate data.

Pointing the sensor end downstream will stop it accumulating debris, however in some channels the sensor body may disturb the velocity distribution unacceptably.

The velocity reading will be positive when pointing upstream and negative when pointing downstream. The STARFLOW may be configured to only read positive velocities regardless of water flow direction. See Flow Measurement Extensions on page 109 for details.

4.4 Power Considerations

If the battery is not continuously recharged either by a solar recharge system or some other recharge system, it may require replacement. All data is preserved for about half an hour, however, it is recommended that you:

STARFLOW is powered from an external 12 volts DC source (12V battery) connected to the signal cable.

In normal operation (1 minute scan rate), the STARFLOW consumes less than 0.8Ah per day. This compares to 3.2Ah per day at a 15 second scan rate (which is the fastest recommended sampling rate). Refer to the section Battery Duration Table on page 18.

If the battery is not continuously recharged either by a solar recharge system or some other recharge system, it may require replacement. All data is preserved for about half an hour, however, it is recommended that you:

1. Unload the data from the STARFLOW.
2. Replace the battery.
3. Program STARFLOW with a Scheme.

If the 12V power is disconnected for more than 30 minutes, recorded data will be lost.

If the 12V power falls below 11V, the STARFLOW will stop recording (it enters "Sleep Mode.").

4.5 Signal Cable and Connections

STARFLOW comes with a 15 metre multi-core, vented signal cable which is terminated into a 7 pin «SQL» weatherproof connector.

The cable connectors are «SQL» compatible and may be extended with «SQL» extensions (or other suitable quality signal cable) up to 35 metres.

4.6 STARFLOW Cable Connection Table

9 Wire Vented Cable			Computer Socket		MODEM Plug
SQL Pin#	Wire Colour	Signal Description	D 25	D9	D25
1	red & orange	+12V – Battery +ve	–	–	9 +12V*
2	yellow	RxD(OUT) – RS-232 serial data from STARFLOW	3	2	2 TXD(IN)
3	black	TxD(IN) – RS-232 serial data to STARFLOW	2	3	3 RXD(OUT)
4	white	RTS(IN) – Request to Send	4	7	8 CD(OUT)
5	purple	SDI-12 – Data In/Out – HSIO Clock and – Counter 0**	–	–	22 RING(OUT)
6	blue	OUT – Pump Sampler – CMOS control HSIO Data	–	–	20 DTR(IN)*
7 centre	green & brown	GND – Battery -ve/signal ground	7	5	7 GND

*Model 6802C Micropower Modem connections.

**When in counter mode, only voltage pulses of 7.5V will be recognised.

4.7 Drying Tube and Desiccant

The STARFLOW cable contains a tube to vent the water depth pressure sensor to atmospheric pressure. It is very important to ensure that NO MOISTURE enters the vent tube, as this will cause erratic depth measurements.

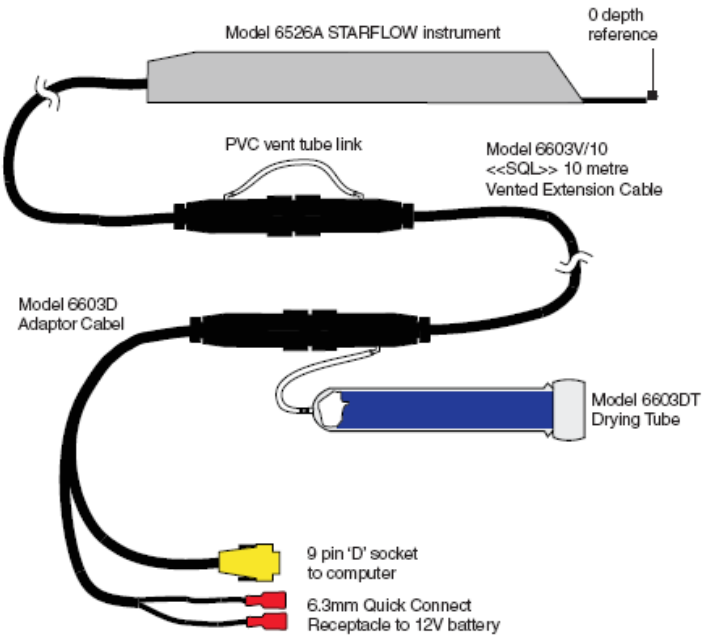
The STARFLOW connector vents the cable through a Drying Tube (Model 6603DT) containing “Silica Gel” desiccant.

Replace or regenerate the desiccant when it changes colour from blue to

pink.

4.8 Extending the STARFLOW Cable

You can use an «SQL» extension cable to extend the STARFLOW cable up to 35 metres. If you are able to install the Drying Tube at the cable interconnection, you can use the standard (non-vented) «SQL» cable extensions. Otherwise you need to use «SQL» vented cable extensions and install the drying tube at the end of the cable extension (remembering to interconnect the vent tube with the external PVC vent tube link).



4.9 Battery, Computer and Modem Connection

The battery, drying tube and computer connectors must be located in a weatherproof enclosure (such as a Model 6701). If the drying tube or battery is inside this enclosure, then it must not be completely sealed, as the drying tube needs to vent to the atmosphere and the sealed lead acid battery may also vent gas during an overcharge condition.

4.10 Remote Telemetry (Modem Requirement)

STARFLOW connects directly to a standard data modem. This allows you to interrogate (examine real time readings and unload recorded data) from your office over a standard telephone line or cellular phone network.

The preferred modem has the following characteristics:

- 12V DC operation with low power modes (Micropower standby mode).
- Power ON with RING DETECT and DTR.
- At least 2400 baud communication rate.
- MNP Class 2–5 and CCITT V.42 bis data compression and error correction.
- 9600 baud computer interface.
- Suitable for switched network or cellular phone operation.

Several brands of modem are available. Contact your nearest UNIDATA supplier for more information.

STARFLOW/MODEM Power Requirements. When communicating with a STARFLOW via a modem, both the STARFLOW and modem remain switched on and consume many times their idle power. Care should be taken to limit communications to 30 minutes per day or increase battery size and solar panel accordingly.

4.11 A Quick Guide to STARFLOW Field Practice

These examples are provided to give you an idea of how to define a Scheme which meets site and operations requirements.

4.11.1 Site interrogated Using Remote Telemetry

If you intend to interrogate STARFLOW using a modem (remote telemetry):

Specify the use of a Circular Log Buffer in the scheme.

Perform Incremental Unloads.

If STARFLOW had a full log buffer, it would take a long time to unload. Over phone lines this may be costly. You can shorten the time by performing an Incremental Unload, that is, only retrieve data logged since the last unload.

Likewise, if you were using this method of unloading, then you'd want the Scheme Log Program to include a circular log buffer. With this type of buffer, the STARFLOW continues to store the most recent data even if the log buffer has been filled. It simply writes the new data over the earliest data stored. Using this system, you will have already unloaded earlier data.

4.11.2 Site Visited at Regular Intervals

You intend to visit the site regularly, unload the full buffer, then Program STARFLOW again as you leave. Well, STARFLOW software will calculate how long you can wait between visits so that data from the site will not be lost.

Use a Linear Buffer in the scheme.

Perform a Full Unload when you retrieve data. You must plan to visit the site before the data buffer is full, otherwise, you'll lose the most recent data. After each unload, you must re-program STARFLOW again before you leave. This resets the scheme to begin logging and the start of memory. If, instead, you choose to use a circular data buffer, the most recent data collected overwrites previous data stored when the log buffer is full. Whereas with a linear buffer, once it is full, most recent data is not stored.

Time Clock Considerations – The STARFLOW's time clock is automatically set to your computer's time whenever you Program the STARFLOW. During normal operation, the STARFLOW time clock may slowly lose or gain time. Over a long period, this may accumulate into a significant time error (especially if you use Incremental Unloads and never re-Program the STARFLOW in normal use. To correct a time clock error, simply re-Program the STARFLOW (remembering to Unload any logged data first.) If you are using a linear buffer and programming the STARFLOW after every Unload, you will not have accumulated time errors.

5.0 STARFLOW Support Software

Starlog Version 4.0 (Starlog V4) is a software package designed for the management of Unidata loggers. It is a standalone software application designed to replace existing Starlog or Starflow software, and provide the advantages of a 100% Windows interface.

Features:

- Powerful scheme creation system.
- Comprehensive instrument library and editor.
- Multiple user profiles (basic, technical, system developer).
- Multi-buffer support.
- Telemetry support.
- Backward compatibility with Starlog version 3 schemes.
- Fully Windows XP compliant.
- Unloads data and converts automatically to a CSV (Comma Separated Value) file for easy data manipulation and viewing in Excel, Hydstra, or Magpie.
- View unloaded data in a graphical and textual format with the internal data viewer.
- View real-time readings from the logger in a graphical or textual format.
- Connect to remote sites via a standard phone or cellular modem.
- Manage multiple sites from a single PC.
- Configure basic parameters of the logger scheme.

Note that at present Starlog V4 is unable to:

- Receive alarms from logger.
- Program/unload to/from PCMCIA memory cards.

5.1 Computer Requirements

- Pentium Processor 233MHz
- 64MB RAM
- 32MB hard drive space
- Windows XP or 2000
- SVGA monitor
- Mouse
- RS232 serial port or USB to serial converter

.

5.2 Installation

5.3 Upgrading From Version 3 Software

Version 4 software cannot automatically convert your version 3 schemes to version 4. If you want to convert your old schemes you will have to do it yourself. If you don't want to convert your old schemes, version 4 software can still use them. Version 3 schemes can be programmed and unloaded. They can also be edited, but that requires a copy of Version 3 software to be installed, as version 4 software cannot edit the scheme, but requires the version 3 scheme editor for that..

If you are installing your new version 4 software on a different computer from your existing version 3 software, it is recommended you move your version 3 software to your new computer before installing your new version 4 software.

This is because the version 4 software can automatically configure itself to access your existing schemes, but only if they are on the same computer.

Version 3 software is typically installed in the `C:\STARLOG` or `C:\STARFLOW` folders. Just copy the folder as-is to the new computer, making sure the folder names stay the same, i.e. copy if it was installed in `C:\STARLOG` on the old computer, copy it to `C:\STARLOG` on your new computer.

If you cannot (or don't want to) move your version 3 software before installing the version 4 software, you can still proceed with the installation, but you may need to manually configure the version 4 software as described under *Starlog V3 Options* on page 40.

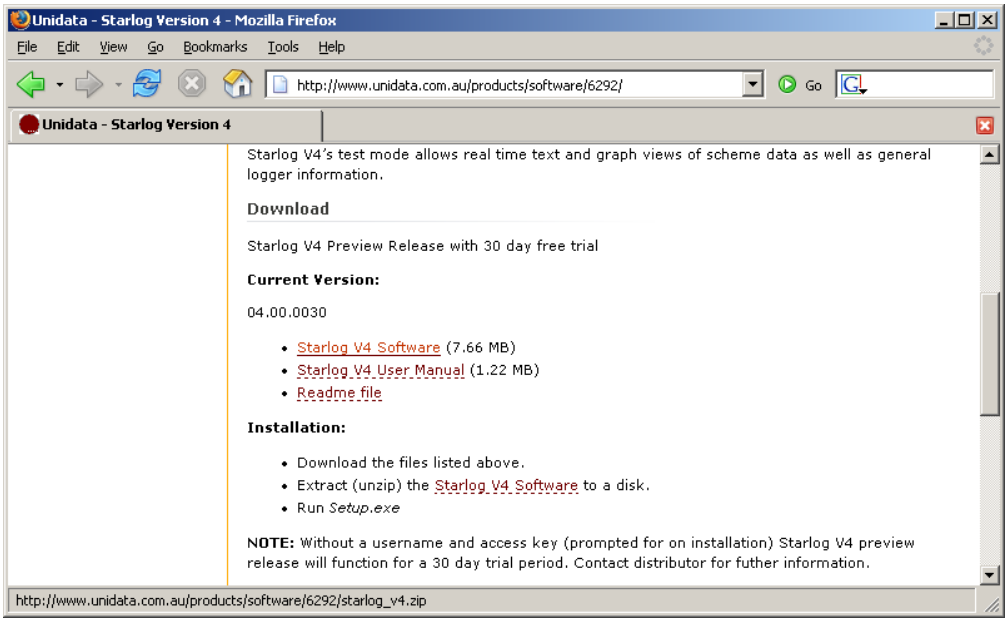
5.4 Starting from CD-ROM

Insert the CD-ROM disc into the drive. It should start automatically. If it doesn't go to `Start → Programs/All Programs → Accessories → Windows Explorer`. Select your CD-ROM drive and double-click on `Launcher`.

5.5 Starting from Downloaded Files

There is a 30-day trial version of Starlog V4 available from our web site.

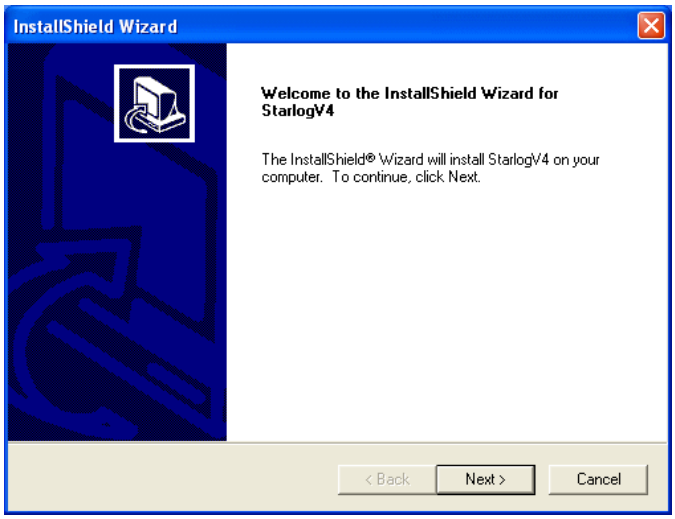
1. To download the required files, go to the Unidata web site:
   http://www.unidata.com.au/products/software/6292/


Unidata - Starlog Version 4 - Mozilla Firefox
File Edit View Go Bookmarks Tools Help
http://www.unidata.com.au/products/software/6292/
Go
Unidata - Starlog Version 4
Starlog V4's test mode allows real time text and graph views of scheme data as well as general logger information.
Download
Starlog V4 Preview Release with 30 day free trial
Current Version:
04.00.0030
Starlog V4 Software (7.66 MB)
Starlog V4 User Manual (1.22 MB)
Readme file
Installation:
Download the files listed above.
Extract (unzip) the Starlog V4 Software to a disk.
Run Setup.exe
NOTE: Without a username and access key (prompted for on installation) Starlog V4 preview release will function for a 30 day trial period. Contact distributor for futher information.
http://www.unidata.com.au/products/software/6292/starlog_v4.zip

2. Click on `Starlog V4 Software` to download `starlog_v4.zip`.
3. Unzip that file into a temporary folder.
4. Open the folder and run the `Setup` file.

5.6 Installing the Software

Having started the installation procedure, you should be seeing the following screen:


InstallShield Wizard
Welcome to the InstallShield Wizard for StarlogV4
The InstallShield® Wizard will install StarlogV4 on your computer. To continue, click Next.
< Back
Next >
Cancel

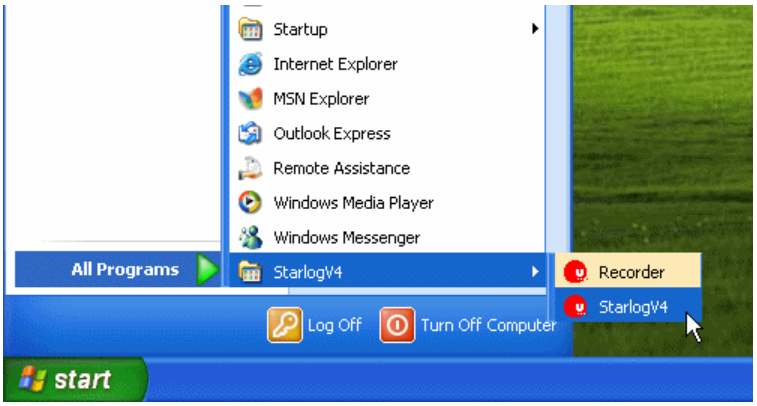
Follow the prompts to install the software. If you are asked to restart your computer, you should do so.

5.7 Using the Software for the First Time

5.7.1 Launching the Software

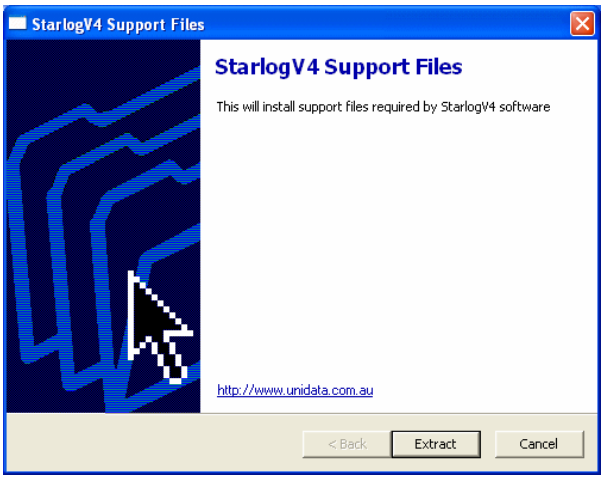
To start Starlog version 4, you can double-click on the icon on your desktop:

Alternatively, you could select the program from the start menu:



5.7.2 *Support Files*

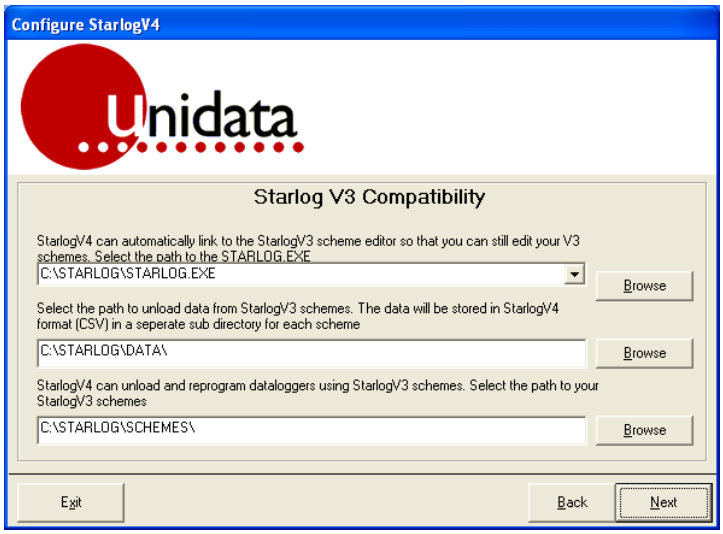
The first time Starlog version 4 is run, it needs to install some extra support files and configure itself:



Click `Extract` to install the support files.

5.7.3 *Backward Compatibility*

The next dialog lets you configure the Compatibility support for Starlog/Starflow version 3 software:

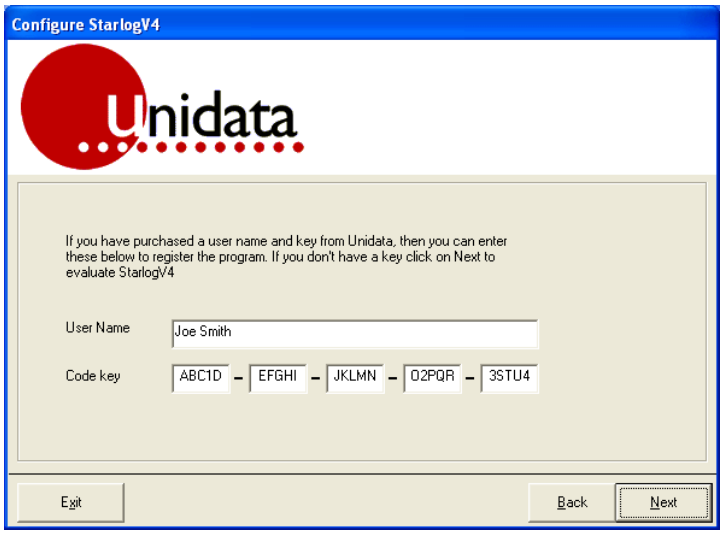

Configure StarlogV4
Starlog V3 Compatibility
StarlogV4 can automatically link to the StarlogV3 scheme editor so that you can still edit your V3 schemes. Select the path to the STARLOG.EXE
C:\STARLOG\STARLOG.EXE
Browse
Select the path to unload data from StarlogV3 schemes. The data will be stored in StarlogV4 format (CSV) in a seperate sub directory for each scheme
C:\STARLOG\DATA\
Browse
StarlogV4 can unload and reprogram dataloggers using StarlogV3 schemes. Select the path to your StarlogV3 schemes
C:\STARLOG\SCHEMES\
Browse
Exit
Back
Next

The above shows a typical configuration. You may need to change the values to suit the configuration of your Starlog/Starflow version 3 installation. If you don't have Starlog version 3 installed, just click `Next` to continue.

If you want to change these later, you can edit them by going to `File` → `Options` → `Configure StarlogV4` → `Starlog V3`. See *Starlog V3 Options* on page 40.

5.7.4 Registration

The next dialog requires you to enter your `User Name` and `Code Key` to register the software. If you don't enter a valid `User Name` and `Code Key` then you have 30 days as a trial user before you are unable to use Starlog version 4. You will have the opportunity to enter a valid `User Name` and `Code Key` every time you restart Starlog version 4.


Configure StarlogV4
If you have purchased a user name and key from Unidata, then you can enter these below to register the program. If you don't have a key click on Next to evaluate StarlogV4
User Name
Joe Smith
Code key
ABC1D - EFGHI - JKLMN - O2PQR - 3STU4
Exit
Back
Next

Assuming what you've entered is correct, you'll see the following:

If you instead see the message `Incorrect key or invalid user name entered`, click `OK`, double-check the values you've entered. If you continue to have problems, contact your software vendor.

The next screen confirms your `User Name` and `Code Key`. Click `Finish` to complete the setup and enter the main software screen.

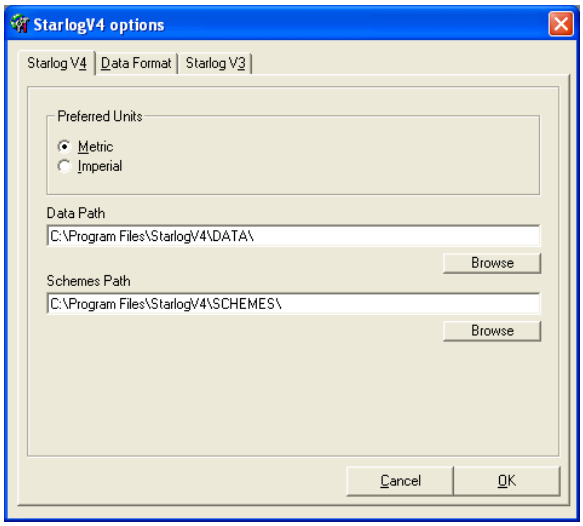
5.7.5 Configuring V4 Options

Once the software is running, it is recommended to check some settings to make sure they are correctly set before doing significant work with Starlog V4.

Go to the `File` menu and select `Options`, then `Configure StarlogV4`.

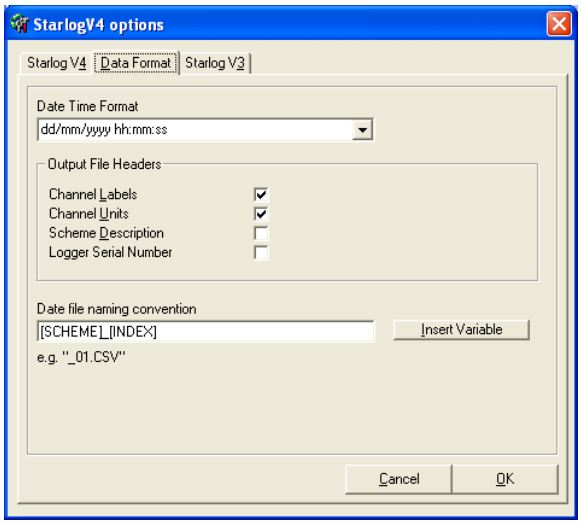
5.7.5.1 Starlog V4 Options

On the `Starlog V4` tab, select your `Preferred Units`. The `Data Path` and `Scheme Path` settings are already set to suitable defaults and should not be adjusted.



5.7.5.2 Data Format Options

On the `Data Format` tab, select your preferred `Date Time Format`. If the format you'd prefer is not listed, you may directly enter the format you'd prefer. `Output File Headers` controls what information is included in the headers for each column of data recorded by your log programs.



In the following sample file:

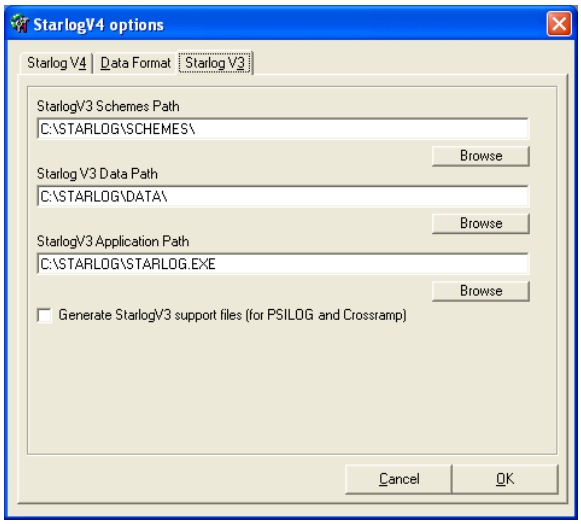
```
test -

S/N: 7434

Time, Voltage(RAW), Voltage(RAW), Temperature(RAW), Humidity(RAW)

 , mV, mV, degC, pct

04/10/2006 15:59:50, 1051.0, 896.0, 26.4, 96.1
```

`test` is the scheme name, `S/N: 7434` is the logger serial number, `Time`, `Voltage(RAW)`, `Temperature(RAW)`, and `Humidity(RAW)` are the Channel Labels (which also incorporates the type of logging), and `mV`, `degC`, and `pct` are the Channel Units.

The remaining lines are the logged data.

5.7.5.3 Starlog V3 Options

On the `Starlog V3` tab you can set the Starlog version 3 folder locations.

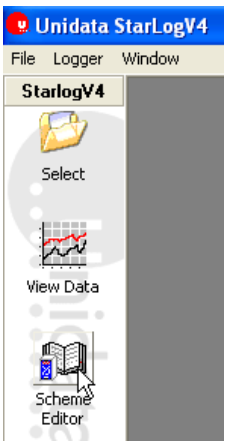


The `StarlogV3 Schemes Path` is the location of your version 3 scheme programs. The `Starlog V3 Data Path` is the location of the data files generated by Starlog version 4 when it unloads loggers programmed using version 3 schemes. The `StarlogV3 Application Path` is the location of the main version 3 executable. This is used to locate the remaining components of the version 3 software.

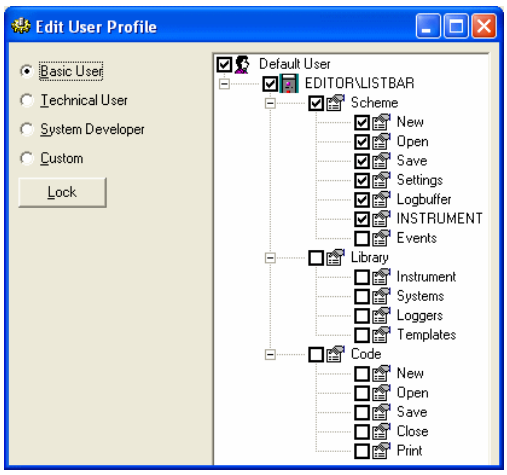
The `Generate StarlogV3 support files` checkbox determines if Starlog version 4 will generate various files used by version 3 software, but no longer required in version 4. Such files include the SCM (version 3 scheme definition), INI (text file of scheme settings), FTU (test display) and ENT (log buffer display). This is to support non-Starlog software packages that look for and use those files.

5.7.6 User Profiles

User profiles are used to simplify the operation of the Scheme Editor by limiting the number of visible options. If you are the only person using the software, you may wish to ensure the full functionality of the software is available.



To adjust user profiles, start the Scheme Editor by clicking on the Scheme Editor icon (see picture to the right) then select `File` → `Setup` → `Profiles`. The following dialog will appear:

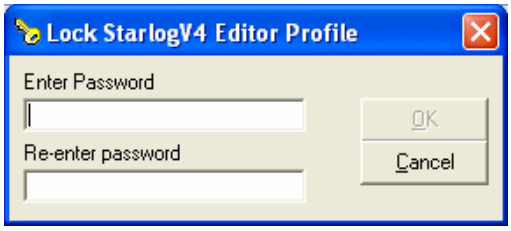


By default Starlog version 4 starts in the `Basic User` profile, which only allows access to a subset of Scheme Editor functionality. The `Technical User` has full access to the Scheme Editor, plus access to the instrument library. The `System Developer` has complete access to all aspects of the Scheme Editor and the various libraries, including data logger definitions and the raw code generated by the Scheme Editor.

If none of the built-in options match your preferences, select `Custom`, which allows you to individually select which Scheme Editor functions are visible.

Once you have made your selection, it is possible to lock the configuration so it cannot be changed. This is useful for when you are setting up a “turnkey” type system where unrestricted use of the Scheme Editor may be inappropriate.

To lock the User Profile, click the `Lock` button.



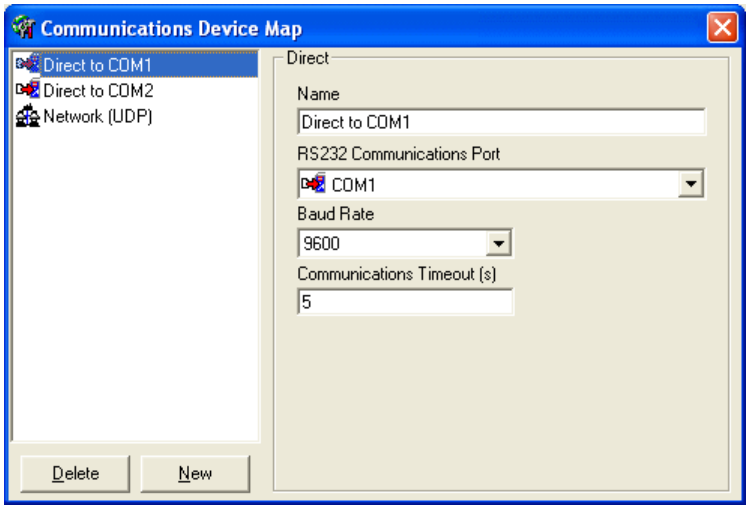
You will need to enter your password twice to make sure you’ve got it right. The `Lock` button will change to `Unlock`. If you need to change the User Profile settings in the future, click the `Unlock` button, enter your password, and make your changes.

5.7.7 Communications Mapping

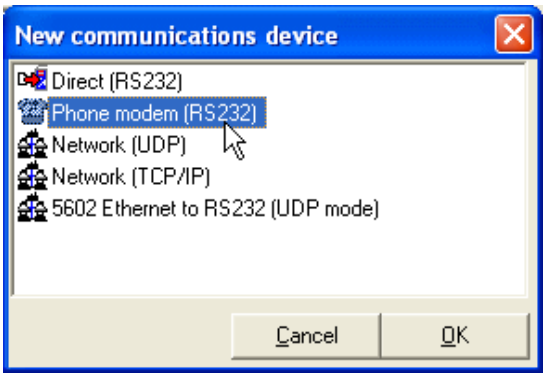
The Communications Map is where you create and name your required communications interfaces. For example, you might have one communication interface for when you connect directly via a serial cable to a local data logger, and a second communication interface (possibly on the same physical serial port as your cable) for when you use a modem to connect to a remote data logger.

You will need to ensure your Communications Maps are correctly configured before you attempt to program or unload a data logger.

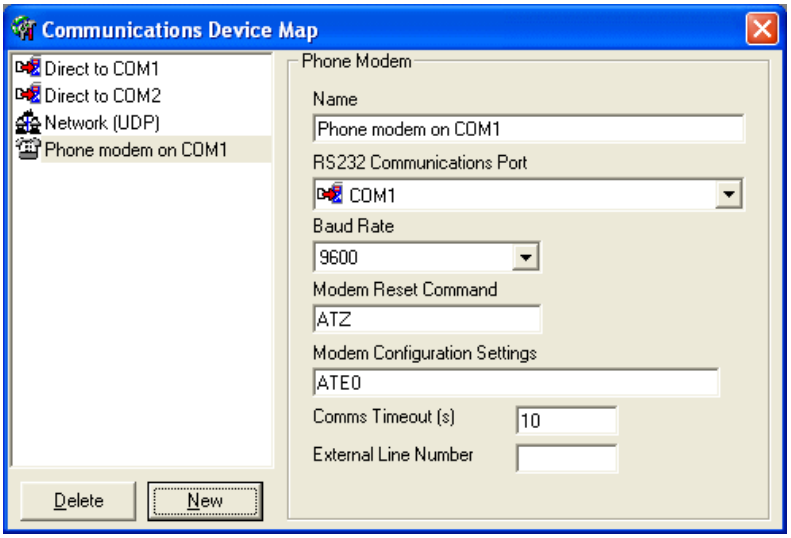
The Communications Map is accessed from the main Starlog V4 window via the menus `File` → `Options` → `Communications Map`.



By default all your physical serial ports will be listed, plus a Network port. The default serial ports are all “direct”. To support modem communication, click the `New` button and select `Phone modem (RS232)` from the list:



Click OK. A new communication map for a modem will be added to your list:



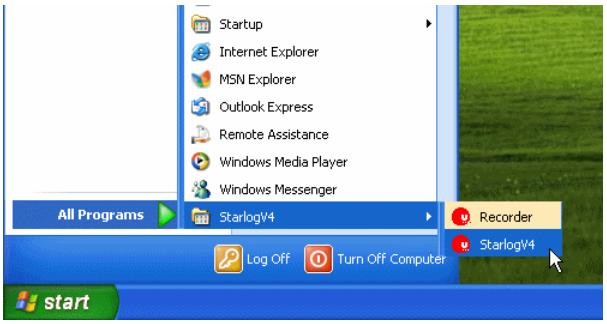
You will now need to configure it to use the correct serial port (RS232 Communications Port), preferred baud rate, and any special dialling prefix numbers to get an outside line if you're on a PABX.

Note that you do not configure any telephone numbers in this dialog. You will select the required Communications Device and set the telephone number when creating/editing a scheme via the Settings dialog in the Scheme Editor. See *Creating / Editing* a Starflow Scheme on page 48.

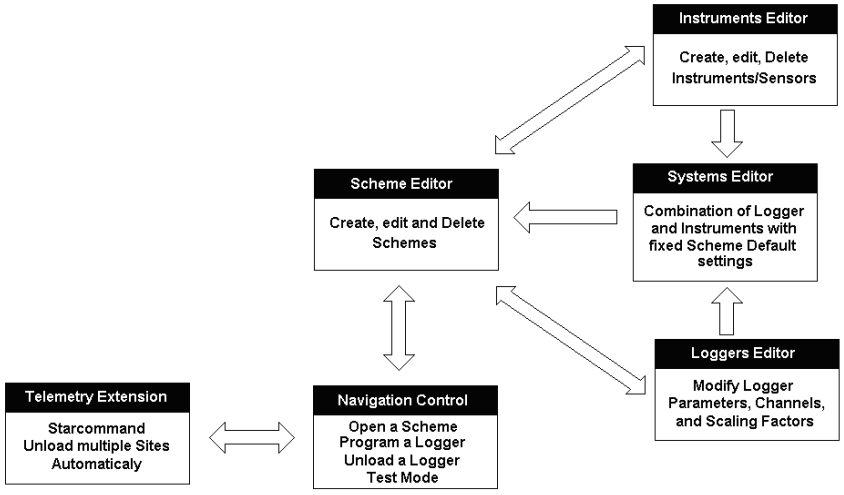
5.8 Starting the Software

To start Starlog version 4, you can double-click on the icon on your desktop:

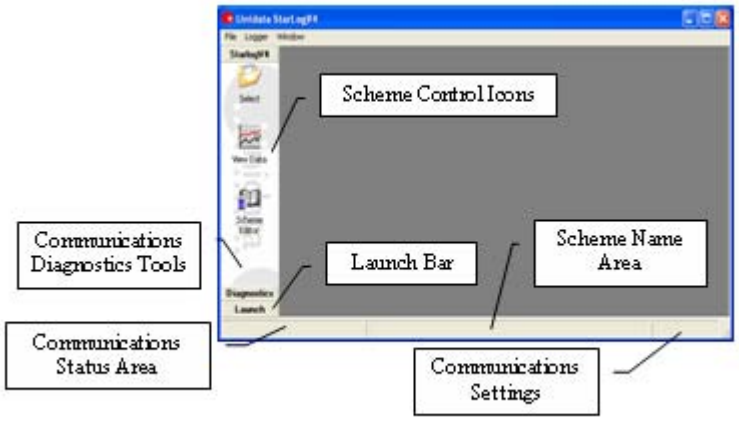
Alternatively, you could select the program from the start menu:



Starlog version 4 has the following program structure:


Instruments Editor
Create, edit, Delete Instruments/Sensors
Scheme Editor
Create, edit and Delete Schemes
Systems Editor
Combination of Logger and Instruments with fixed Scheme Default settings
Loggers Editor
Modify Logger Parameters, Channels, and Scaling Factors
Telemetry Extension
Starcommand Unload multiple Sites Automaticaly
Navigation Control
Open a Scheme Program a Logger Unload a Logger Test Mode

The most common logger operations are simple to start from the main Starlog window. The main Starlog version 4 window and major functional areas are shown below:



- **Scheme Control Icons**: These provide access to scheme-related functionality, such as selecting a scheme, editing a scheme, and viewing data logged by the scheme. If you can't see them, click on the `Starlog V4` button to show them.
- **Communications Diagnostics Tools**: These provide access to tools useful for troubleshooting communications problems. Click on the `Diagnostics` button to show them.
- **Launch Bar**: This is where you can add groups of external applications. Such applications might include custom data analysis tools you may have. When you add your first external application, the "Launch" button will be replaced with a button labelled with the name of your nominated group. As you add applications with different group names, buttons for each group will be added to the bottom of the bar. See also ***Error! Reference source not found.*** on page **Error! Bookmark not defined.**.
- **Communications Status Area**: This will read `Connected` when you are connected to a logger, and `Disconnected` (or blank) when you are not connected to a logger.
- **Scheme Name Area**: This shows the name of the currently selected scheme.
- **Communications Settings**: When connected to a logger, this shows the used communication settings. For example: `COM1:9600,N,8,1`, which indicates that COM1 is the port used, the baud rate is 9600, N means no parity, 8 is the number of data bits, and 1 is the number of stop bits.

5.9 Finding the Version of the Software

To find out what version of Starlog version 4 you have, select `About StarlogV4` from the `Window` menu. A window similar to the following will appear:

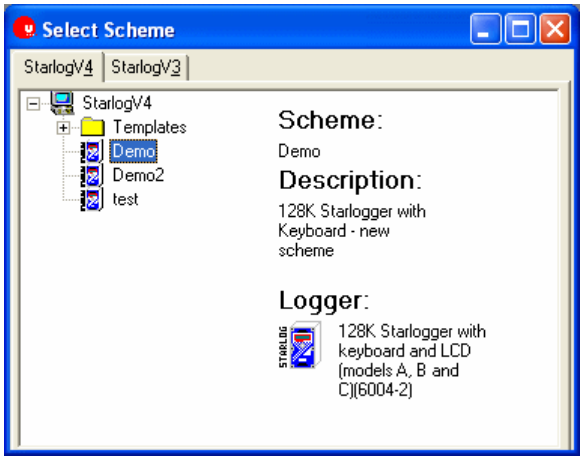
Version 04.00.0039
© June 2005
By: Steve de Lima
http://www.unidata.com.au
This program is registered to: Unidata Training
Program Serial Number 00001
Single User Edition - this license may only be used on one PC at a time
StarlogV4 - Unidata logger management application.
Close

The version number is shown at the top right ("04.00.0039"). When requesting technical support in relation to the software or your schemes, always mention the version of your software.

6.0 Scheme Management

6.1 Selecting a Scheme

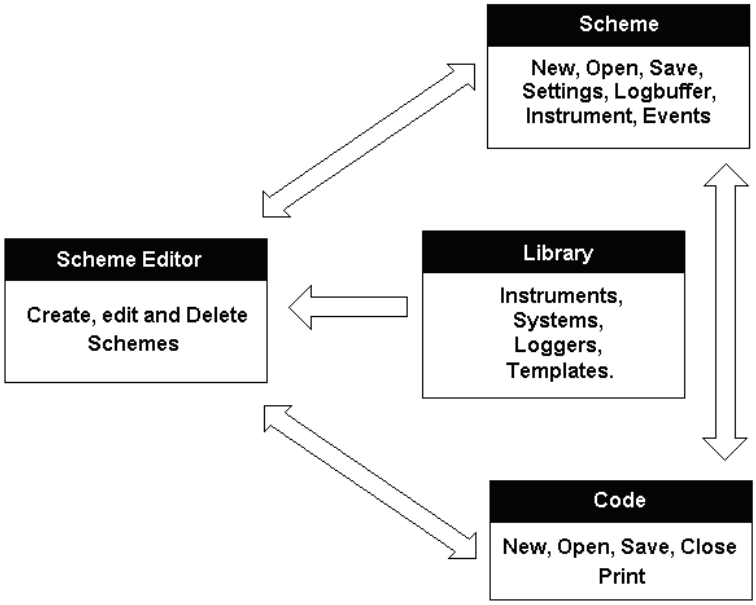
To select a scheme, click the Select icon (shown to the right). The following window will appear if schemes have already been created:



The tabs at the top allow you to view all your version 4 schemes and all your version 3 schemes (if you have any). Select a scheme by double-click its name.

6.2 Creating / Editing a Starflow Scheme

The Scheme Editor is used to create, edit and delete schemes. It can also create templates and data logging systems. The program structure is shown below:



The Scheme section is mainly used for creating and editing schemes with standard functionality.

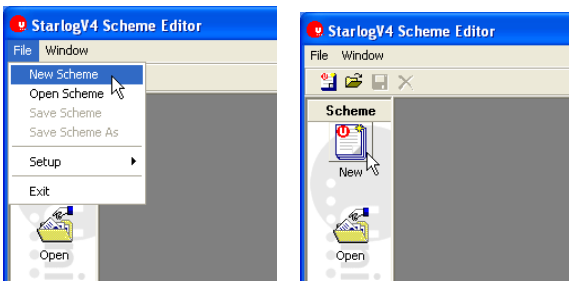
The Library section is used for modifying the available libraries. Organisations with standard logging systems can create templates to suit those systems. There is essentially no limit to the systems that can be built.

The Code section is for those schemes with extended functionality that require custom code. It contains a Code editor with tools that assist layout and increase readability.

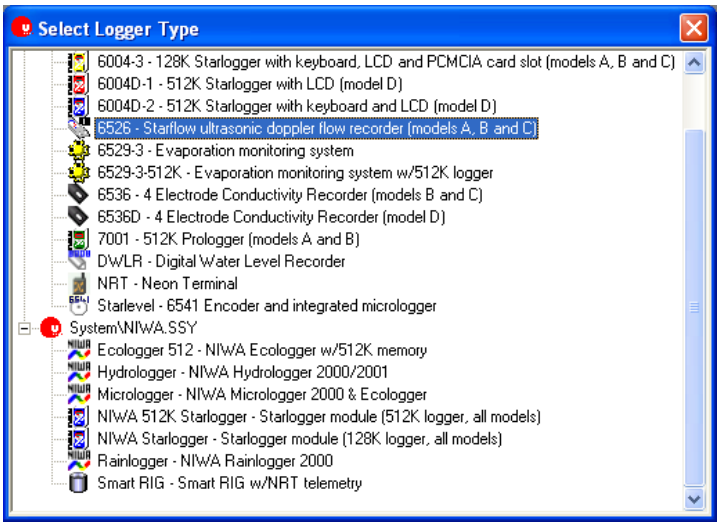
To create a scheme, you need to open the Scheme Editor. Click on the `Scheme Editor` icon in the main window (as shown to the left).

NOTE: Version 4 software cannot edit version 3 schemes. You must keep a copy of version 3 software installed if you want to edit your old schemes.

When the Scheme Editor is open, select `New Scheme` from the `File` menu, or click the `New` icon on either of the toolbars:



A list of data loggers will appear. Select the 6526 – Starflow ultrasonic Doppler flow recorder by double-clicking it. For example, a “6004-2” is selected below:

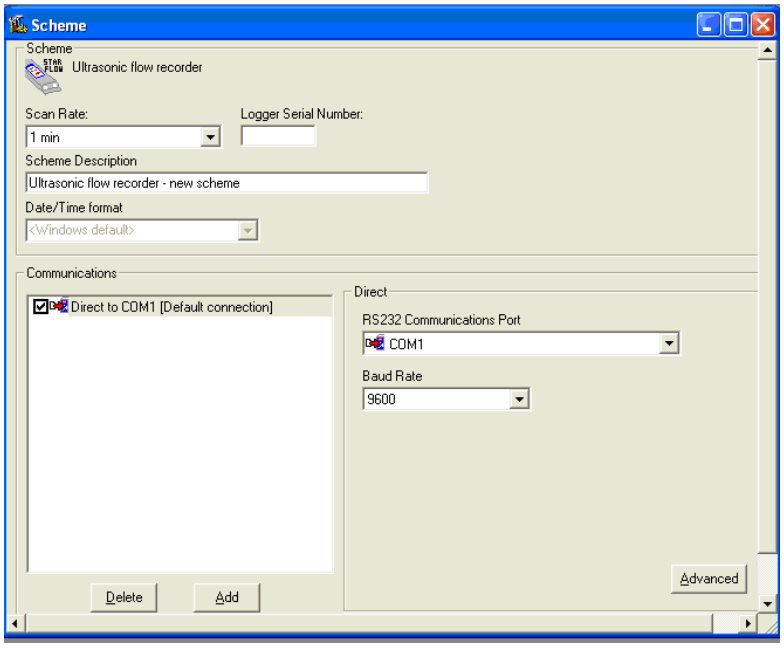

Select Logger Type
6004-3 - 128K Starlogger with keyboard, LCD and PCMCIA card slot (models A, B and C)
6004D-1 - 512K Starlogger with LCD (model D)
6004D-2 - 512K Starlogger with keyboard and LCD (model D)
6526 - Starflow ultrasonic doppler flow recorder (models A, B and C)
6529-3 - Evaporation monitoring system
6529-3-512K - Evaporation monitoring system w/512K logger
6536 - 4 Electrode Conductivity Recorder (models B and C)
6536D - 4 Electrode Conductivity Recorder (model D)
7001 - 512K Prologger (models A and B)
DWLR - Digital Water Level Recorder
NRT - Neon Terminal
Starlevel - 6541 Encoder and integrated micrologger
System\NIWA.SSY
Ecologger 512 - NIWA Ecologger w/512K memory
Hydrologger - NIWA Hydrologger 2000/2001
Micrologger - NIWA Micrologger 2000 & Ecologger
NIWA 512K Starlogger - Starlogger module (512K logger, all models)
NIWA Starlogger - Starlogger module (128K logger, all models)
Rainlogger - NIWA Rainlogger 2000
Smart RIG - Smart RIG w/NRT telemetry

Three new icons will appear inside the left toolbar: `Settings`, `Instruments`, and `Log Buffer`.

6.2.1 Settings

These are settings for controlling basic logger functionality.

Click on the `Settings` icon:



One of the most important settings is the `Scan Rate`. This defines how often the logger scans (samples) its inputs. Faster scan rates make it more likely the data logger will capture accurate minima and maxima, but will shorten the battery life.

The scan rate also influences averaging. If you want to log average data every 15 minutes, then a 5 second scan rate implies 15×60÷5=180 samples. If you don't need that many samples, you could increase the scan rate to maximize battery life.

Another limit the scan rate imposes is on the maximum logging interval. The maximum log interval is 65535 times the scan rate. For example, if you set the scan rate to 1 second, the maximum logging interval is 65535 seconds, or 18 hours 12 minutes 15 seconds. If you want a log interval of 1 day, you would need a scan rate of at least 2 seconds.

The `Logger Serial Number` is optional, and may be left blank.

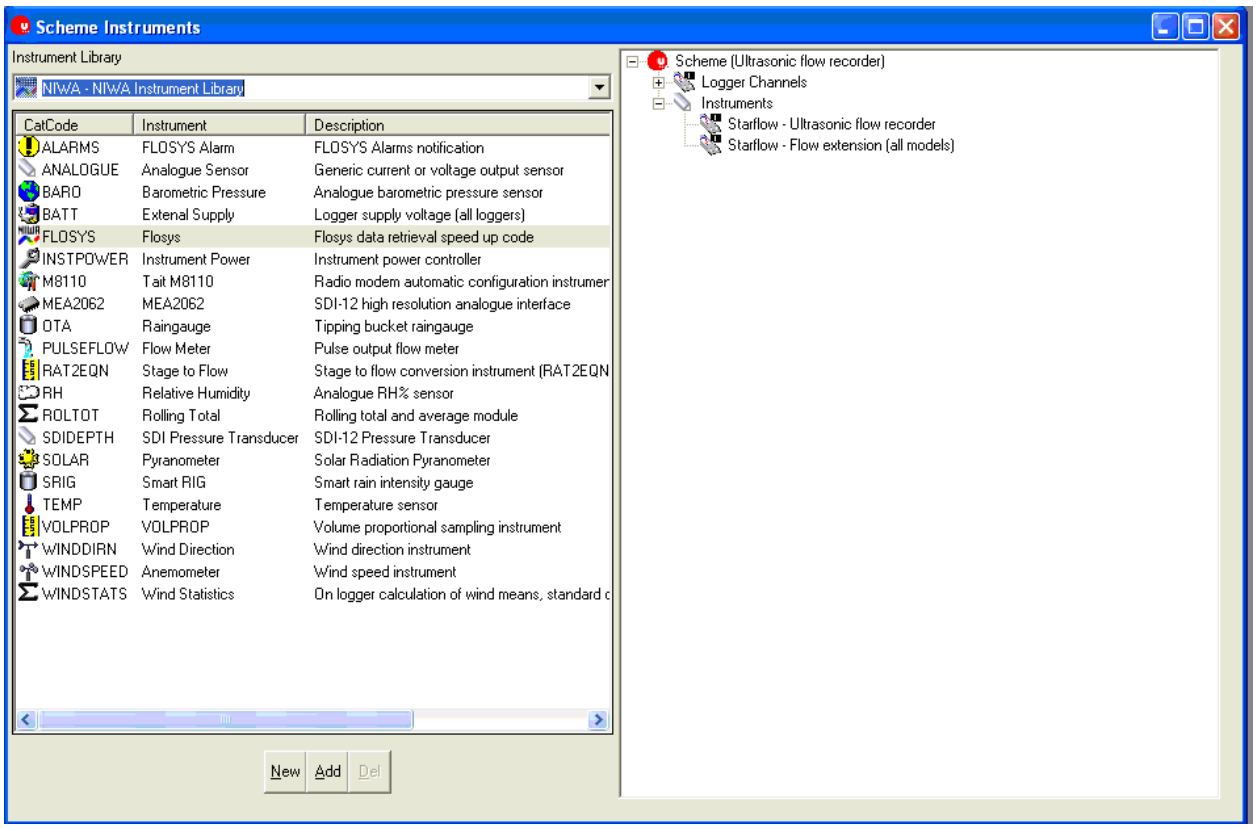
The `Scheme Description` should be set to something that will assist you in remember what the scheme is for.

Apart from the `Scan Rate`, the `Communication` settings are the next most critical. If they're wrong, you won't be able to program or unload your logger! You should have configured your communications settings earlier under *Communications Mapping* on page 43.

6.2.2 *Instruments*

The Instruments window lets you define what instruments are connected to the logger. Instruments define the relationship between what the logger measures (voltages, pulses/counts, digital data) and what the instrument measures (temperature, depth, wind speed, etc).

Click on the `Instruments` icon (shown to the right):


Scheme Instruments
Instrument Library
NIWA - NIWA Instrument Library
CatCode
Instrument
Description
ALARMS FLOSYS Alarm FLOSYS Alarms notification
ANALOGUE Analogue Sensor Generic current or voltage output sensor
BARO Barometric Pressure Analogue barometric pressure sensor
BATT Extenal Supply Logger supply voltage (all loggers)
FLOSYS Flosys Flosys data retrieval speed up code
INSTPOWER Instrument Power Instrument power controller
M8110 Tait M8110 Radio modem automatic configuration instrumer
MEA2062 MEA2062 SDI-12 high resolution analogue interface
OTA Raingauge Tipping bucket raingauge
PULSEFLOW Flow Meter Pulse output flow meter
RAT2EQN Stage to Flow Stage to flow conversion instrument (RAT2EQN
RH Relative Humidity Analogue RH% sensor
ROLTOT Rolling Total Rolling total and average module
SDIDEPTH SDI Pressure Transducer SDI-12 Pressure Transducer
SOLAR Pyranometer Solar Radiation Pyranometer
SRIG Smart RIG Smart rain intensity gauge
TEMP Temperature Temperature sensor
VOLPROP VOLPROP Volume proportional sampling instrument
WINDDIRN Wind Direction Wind direction instrument
WINDSPEED Anemometer Wind speed instrument
WINDSTATS Wind Statistics On logger calculation of wind means, standard c
New
Add
Del
Scheme (Ultrasonic flow recorder)
Logger Channels
Instruments
Starflow - Ultrasonic flow recorder
Starflow - Flow extension (all models)

The `Instrument Library` lets you select from major groups of instruments. Starlog version 4 Software comes with the following predefined groups:

- Loggers – Unidata logger instruments
- PDLTRANS – Unidata Instrument Library
- NIWA – NIWA Instrument Library

When you select an Instrument Library, all the instruments in the library relevant to the selected logger are shown.

The right half of the Instruments window shows the instruments that have been added to your scheme you will now see for the Starflow:

Starflow – Ultrasonic flow recorder

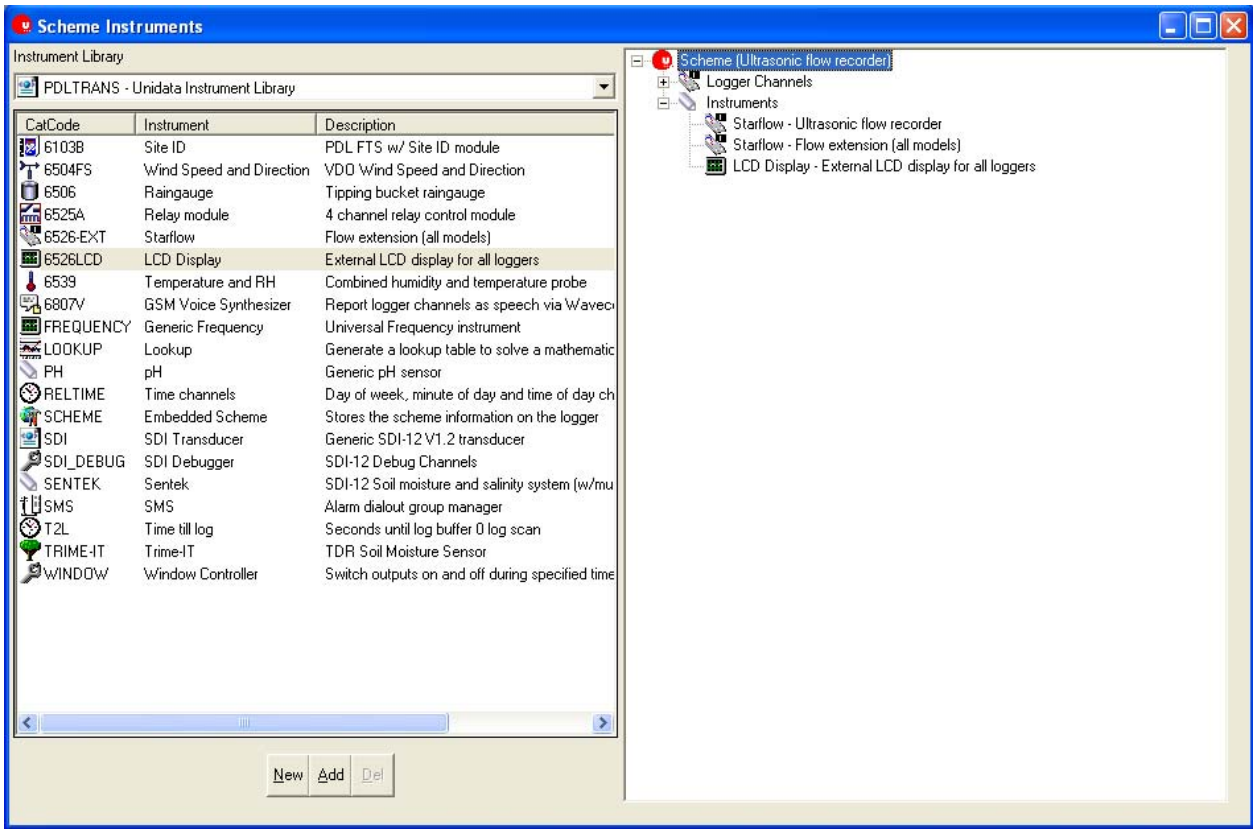
Starflow – Flow extension (all models)

6.2.2.1 Adding an Instrument

To add an instrument to your scheme, either double-click on its line in the left half of the window, or select it then click the `Add` button at the bottom of the window. A copy of the instrument will be added to the list in the right half of the window.

For example, to add the a Starflow LCD Module instrument to your scheme:

1. Edit the scheme and select the Instruments icon.
2. Select the `PDLTRANS` library.
3. Select the `SMS` instrument in the list.
4. Click the `Add` button to add the instrument to the scheme.



6.2.2.2 Removing an Instrument

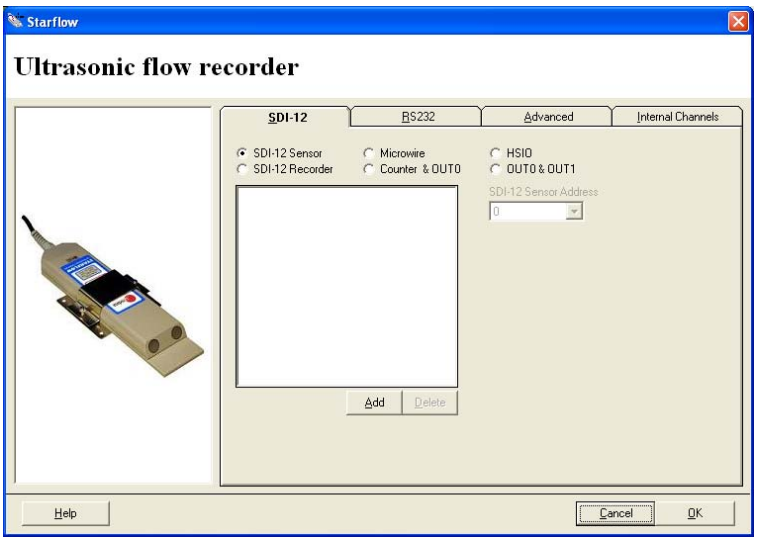
To remove an instrument from your scheme, select it from the list in the right half of the instrument window and click the `Del` button at the bottom of the window, or right-click on it and select `Delete` from the menu.

6.2.2.3 Configuring an Instrument

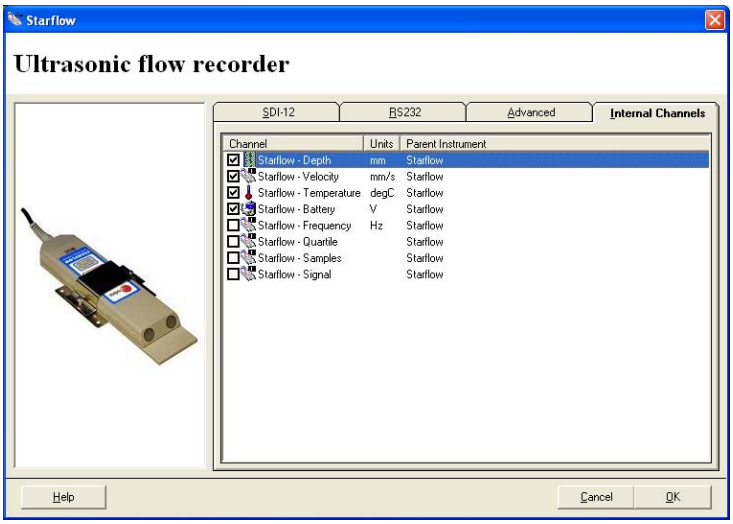
To configure an instrument, double-click on its line in the right half of the window, or right-click on it and select `Edit` from the menu. Different instruments have different configuration windows and options.

Configuring the Starflow

Starflows are configured just as if they were a regular instrument. When you create a scheme, an instrument for the Starflow is always added as the first instrument. Double-click on it. For Starflows, the following window will appear



The various tabs show the options available. If you want internal logger channels to be available for logging (e.g. temperature, battery, quartile, samples), you will need to make sure their entries on the `Internal Channels` tab are ticked.

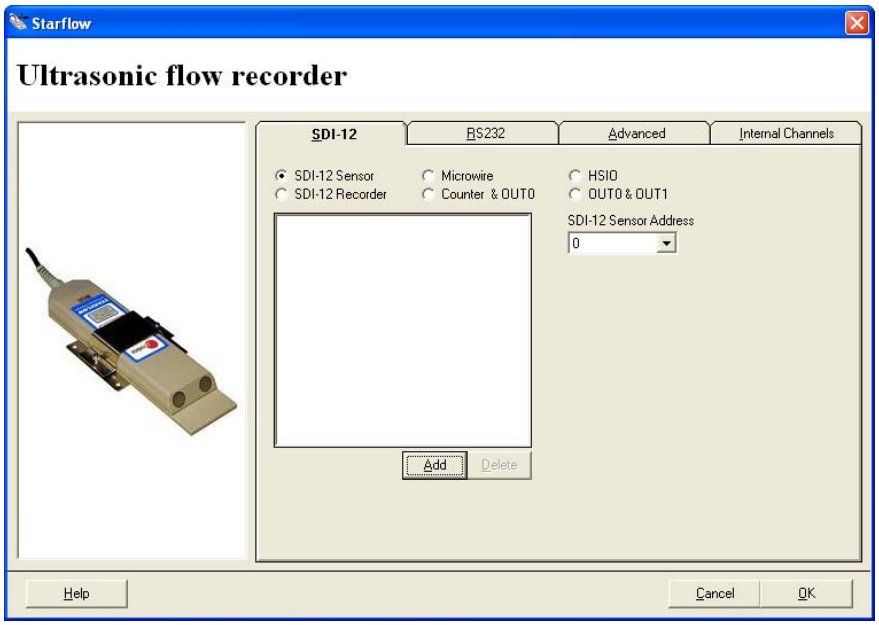


With a Starflow it is always recommended that Frequency, Quartile, Samples and Sinal are ticked in the internal channels TAB.

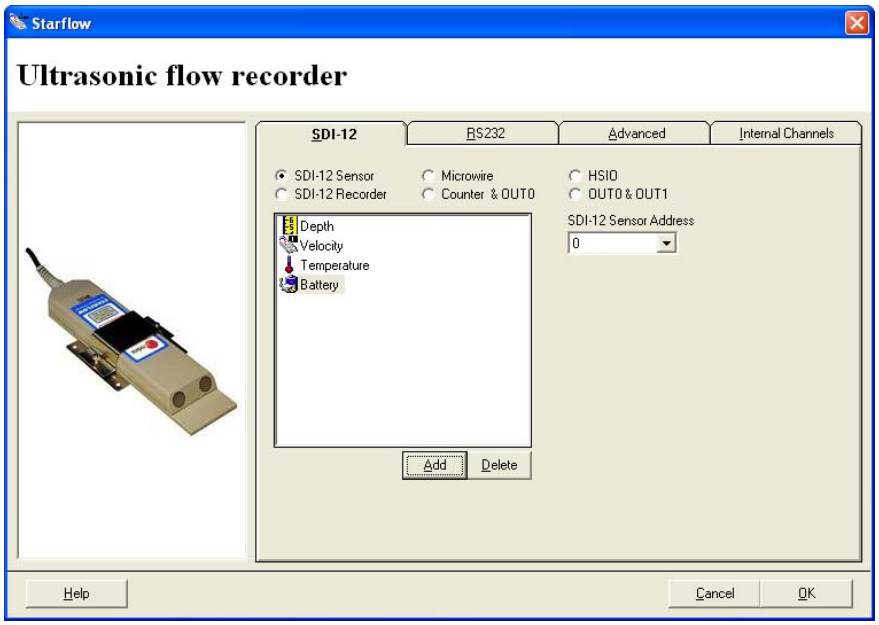
6.2.2.4 Configuring the Logger as an SDI-12 Sensor

When the Starflow is an SDI-12 sensor, other SDI-12 recorders can access and log data sensed by it. This can be useful if you have something with a limited number of inputs, such as a Starflow, but would prefer to have all data at a site logged by a single logger. You could configure the Starflow as an SDI-12 sensor, and use a Starlogger as an SDI-12 recorder to log the depth/velocity/flow from the Starflow, as well as whatever other instruments you have (eg wind speed/direction, air temperature, rainfall).

To set a logger up as an SDI-12 sensor, first add any required instruments to the logger. Then open the logger instrument (as described under *Configuring the* above) and select the `SDI-12` tab. Tick `Enable SDI-12 Sensor Mode` to enable the controls. Next, select the SDI-12 `Address` to assign to the logger. Finally, for each channel you want to make available as an SDI-12 reading, click the `Add` button to add it. The following window will appear allowing you to select from the available channels:



Double-click on a channel to add it to the list. Each added channel becomes an SDI-12 value, numbered from zero starting at the top. The following shows “Battery” as parameter 0, and “Internal Temp” as parameter 1:



6.2.2.5 Configuring the Logger RS232/UPS

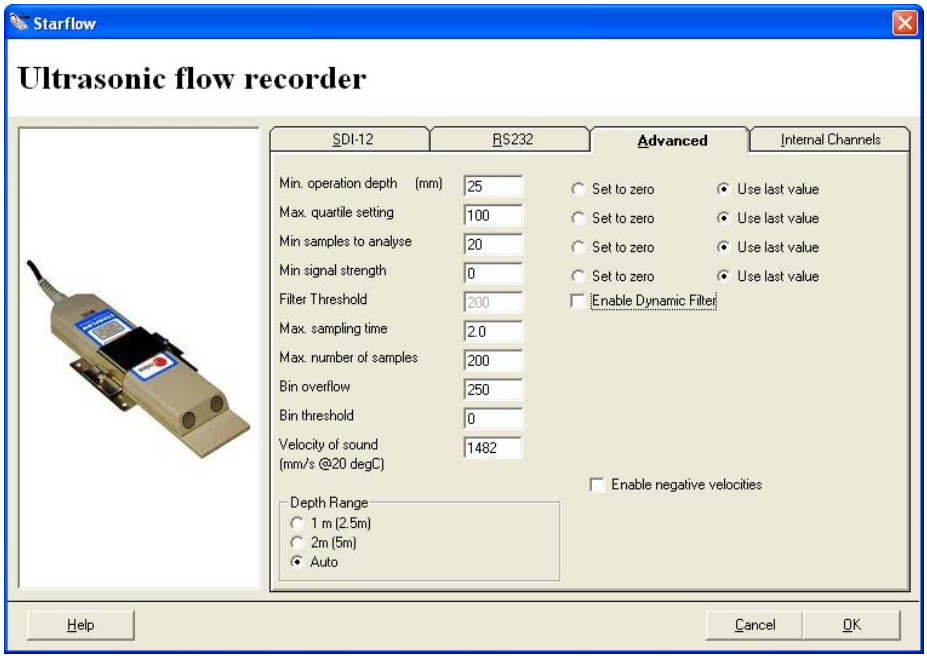
Open the logger instrument (as described under *Configuring the* above) and select the `RS232 / UPS` tab.

The `RS232 Timeout` controls how long the logger will remain powered on and ready to communicate at each scan interval. The factory default for most loggers is 1 second, which is adequate for direct serial cable connections. However, if communications is to take place via a modem, then this should be extended to 3-5 seconds (or more, as required). Longer timeouts will lead to increased power consumption while the logger is communicating.

The `Scan Synchronous Communications` checkbox fine-tunes when the logger checks for a computer attempting to communicate with it. When this checkbox is ticked, the logger will wait until the end of a scan before checking to see if there is a computer wanting to communicate with it. When this checkbox is not ticked, the logger does not wait. After this first check, the logger will only check that the computer is still connected at the end of each scan, regardless of the setting of this checkbox. For quick scan rates, this setting does not do much, however, for slower scan rates, clearing this checkbox (to select asynchronous communication) may improve the logger's responsiveness to communications.

6.2.2.6 Configuring the Starflow Advanced options

The advanced option TAB contains very important factors which are used to interpret the Starflow data. The table below shows the default settings set by the software for general flow operation:



Options those are likely to be configured:

Min operating Depth: The Starflow minimum operating depth is set to 25mm this is the minimum depth which is required in order for the Starflow to operate in the correct manner.

Max Quartile Setting: The quartile setting is used to determine how accurate the data being reported is and if the Starflow is picking up good signals or bad signals, if a quartile higher than 100 is generated this generally says that the data being recorded is unreliable.

Min Samples to analyse: The Starflow requires a certain number of samples to determine if the data being provided is accurate, the default setting is 20 and this is recommended, if there is less than this then the data could be widely spread causing inaccuracies in reported data.

Max number of samples: This setting allows the Starflow to receive a certain number of samples during a scan rate period, in general the more samples the better as then your range of velocity samples becomes more accurate, in general circumstance 200 samples is enough for good data quality but in poor flow areas this should be increased to 500.

Other buttons: The other factors are factory defaults and should not be changed.

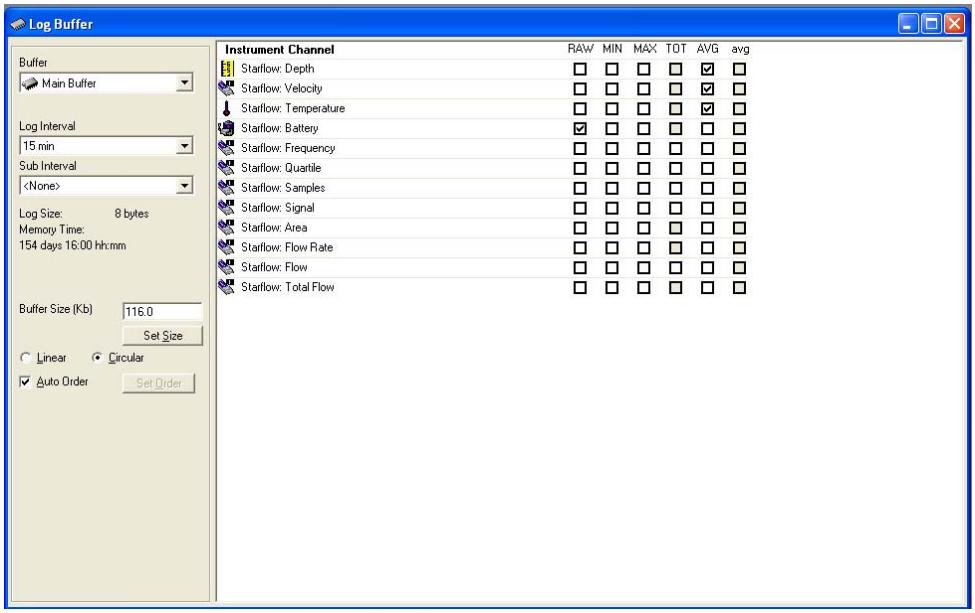
Set to zero or use last value: If one of the CDT criteria is not met (e.g. quartile > 100 or Min samples to analyse < 20) then the software will either record a zero or the last value obtained, in general flow conditions and for data quality a zero is usually advised.

More detail of these settings can be found on page 86.

6.3 Log Buffer

Open the Log Buffer window by clicking on the icon shown to the right:

The Log Buffer window is shown below:



The Log Buffer window is where you set up the logger memory for recording data by selecting what to log and how often to log it.

Data loggers have one Main Buffer and multiple Event Buffers. Event Buffers tend to be small and are used to store data logged on an ad-hoc basis. Whatever memory is not allocated to Event Buffers is allocated to the Main Buffer. Since Event Buffers default to zero bytes, the default Main Buffer size is all the available memory.

6.3.1 Instrument Channels

Each Buffer has its own set of the Instrument Channel checkboxes. You control which of the available channels gets logged into each buffer. The following channel logging options are available; however, some instrument channels may not support all of them (for example, temperature cannot be totalised):

Option	Description
RAW	The instantaneous value of the channel at the time of the log.
MIN	The minimum of the values sampled at each scan over the **log interval** (see *Log Intervals* below).
MAX	The maximum of the values sampled at each scan over the **log interval** (see *Log Intervals* below).
TOT	The total of the values sampled at each scan over the **log interval** (see *Log Intervals* below).
AVG	The average (arithmetic mean) of the values sampled at each scan over the **log interval** (see *Log Intervals* below).
avg	The average (arithmetic mean) of the values sampled at each scan over the **sub interval** (see *Sub Intervals* below).

In the example screenshot shown on page **Error! Bookmark not defined.**, both the Battery and Internal Temperature channels are logging the “AVG” (average of the full log interval).

As you tick channels to log, or adjust the Log Interval, the software will automatically update the Memory Time to show you an estimate for how long the memory will last. The estimate does not take into account logging forced by events.

6.3.2 Log Intervals

The `Log Interval` is the time between logs. Only the Main Buffer has a Log Interval setting. Event Buffers do not have a Log Interval because logging into them is always triggered by events.

At each log, all the Instrument Channels ticked will be recorded into the Log Buffer.

In the screenshot above, the average internal Battery and Temperature Channels will be logged every 15 minutes.

The maximum log interval is limited by the scan rate. The maximum log interval is 65535 times the scan rate. For example, if you set the scan rate to 1 second, the maximum logging interval is 65535 seconds, or 18 hours 12 minutes 15 seconds. If you want a log interval of 1 day, you would need a scan rate of at least 2 seconds.

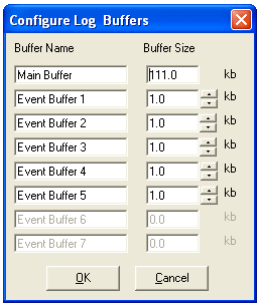
6.3.3 Sub Intervals

The Sub Interval setting only relates to the “avg” column of Instrument Channel checkboxes (not the “AVG” column, or any other column). Rather than take samples at each scan like the “AVG” column, the “avg” column only takes samples during the Sub Interval. The Sub Interval is always the time immediately before a Log. Event Buffers do not support the Log Interval or Sub Interval settings.

For example, if the Log Interval is 60 seconds, and the Sub Interval is 20 seconds, for the first 40 seconds of the 60 second log cycle only the “MIN”, “MAX”, and “AVG” channels will take samples. For the remaining 20 seconds before the log occurs (the Sub Interval), all channels (including the “avg” channel) will be taking samples.

6.3.4 Buffer Sizes

Event Buffers must have their size manually allocated. The Main Buffer size cannot – it is always allocated whatever memory is left after memory has been allocated to the Event Buffers. Click the `Set Size` button to configure the buffers:



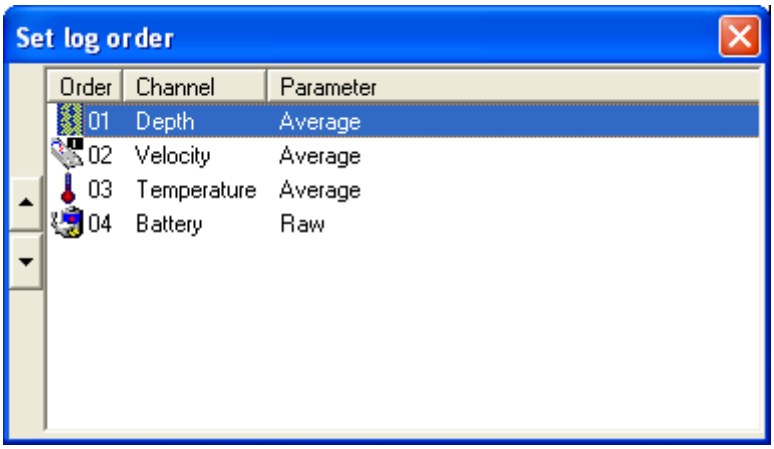
You can adjust the sizes of the Event Buffers in 1KB increments by clicking on the small up/down buttons to the right of the Event Buffer Size field. Increasing the size of an Event Buffer will decrease the size of the Main Buffer by a corresponding amount, and vice versa.

Note that the total capacity of all the buffers will always be less than the quoted memory capacity of your data logger. The data logger reserves some memory for the scheme program, working variables, communications buffers and configuration data.

6.3.5 Other Buffer Settings

Settings common to all buffers are:

- **Linear / Circular**: When Linear buffers fill up, they stop accepting new logged data. When Circular buffers full up, they wrap around to the beginning and start overwriting the oldest data.
- **Instrument Channel Ordering:** This defaults to Auto Order, however, you can untick the checkbox and click on the Set Order button to manually set the logging order of the channels:



Click on the channel to select it, then click on the up/down buttons on the left to nudge it up/down the list.

6.4 Events

Events allow the logger to act on changes on its inputs. Various actions include triggered logging, SMS alerts and relay control. A maximum of 32 events are supported.

6.4.1 Types of Events

There are many different types of events:

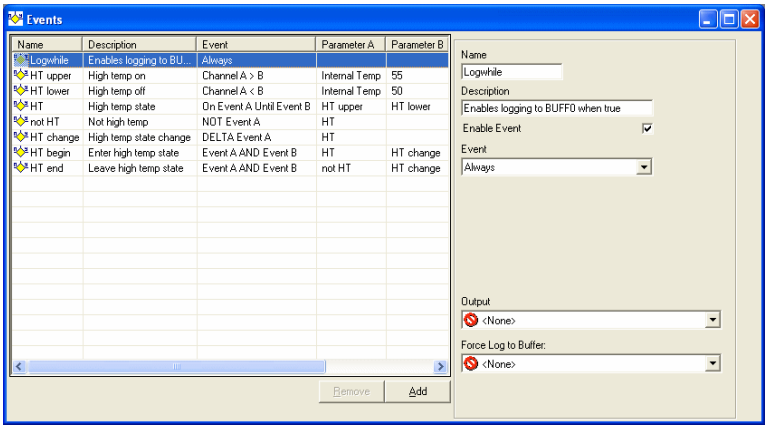
Event Type	Description
None	
Always	An event that is always TRUE.
Channel A > B	Compares channel A with a fixed value B NOTE: "<>" is "not equal" (≠).
Channel A >= B	
Channel A < B	
Channel A <= B	
Channel A = B	
Channel A <> B	
Channel A > Channel B	Compares a channel A with a second channel B. NOTE: There are no "less than" comparisons as "Channel X < Channel Y" is the same as "Channel Y > Channel X".
Channel A >= Channel B	
Channel A = Channel B	
Channel A <> Channel B	
Delta Channel A > B	Monitors channel A and becomes TRUE for one scan when that channel has changed by more than B since the last time the event was triggered. If channel A has

Event Type	Description
	changed by more than B since the event was last true, the extra difference is forgotten for determining when the event will next be true. If the remainder is important, use the "Every B on Channel A" event.
Event A AND Event B	Becomes TRUE when both event A and event B are TRUE
Event A OR Event B	Becomes TRUE when either or both of event A or event B are TRUE
Delta Event A	Becomes TRUE for one scan when event A changes state (from FALSE to TRUE, or from TRUE to FALSE)
Every B on Channel A	Every scan the absolute difference between the current channel A reading and that of the previous scan is added to an accumulator. When that accumulator exceeds B, the event is true for that scan and B is subtracted from the accumulator. Both rises and falls add to the accumulator, so that a rise of 3 units and a fall of 2 would result in an accumulation of 5 units.
NOT Event A	Evaluates to the opposite of event A. If event A is TRUE, this event is FALSE, and vice versa.
On Event A for B Scans	This event becomes TRUE when event A becomes TRUE, and is held TRUE for B scans.
On Event A Until Event B	This event becomes TRUE when event A becomes TRUE, and stays TRUE until event B becomes TRUE.
Event A TRUE for B Scans	This event becomes TRUE for one scan whenever event A has been TRUE for B consecutive scans.
Channel A between B and C	This event is TRUE whenever channel A is between the values B and C inclusive.
Channel A bit B set	This event is TRUE when bit B of channel A is set.
Channel A bit B not set	This event is TRUE when bit B of channel A is not set.

6.4.2

6.4.3 Event Settings

To edit events, click on the `Events` icon (as shown to the right). The default Basic **User Profile** is configured to hide the `Events` icon. You will need to enable it by following the instructions under *User Profiles* on page 41. Make sure the Scheme → Events option is ticked. The following window will appear:



Each event has a name, a description, a type, between zero and three parameters, an output action, and a force log action:

- **Name**: While there is no particular length limit, this should be a short mnemonic of the event. It is what is shown when another event refers to the event, and in the parameter list boxes for those events that take other events as parameters. You don't see the description in those list boxes, so make sure the name will be enough to remember the purpose of each event.
- **Description**: This can be a longer description of the event.
- **Event**: This specifies the type of the event. See the table under *Types of Events* on page 64.
- **Parameter A**: Depending on the type of event this may be a channel or another event.
- **Parameter B**: Depending on the type of event this may be a channel, another event, or a constant value.
- **Parameter C**: So far, only the "Channel A between B and C" uses this parameter (as a constant value).
- **Output**: This is a list of the possible actions the logger can perform for every scan that the event is true.
- **Force Log to Buffer**: For every scan the event is true, this will force the selected log buffer to log the channels as configured in the Log Buffer window (see *Log Buffer* on page 59).

6.4.4 Using Events

Using events can become complicated because while each event by itself is very simple, to get even moderately complex behaviour several events may need to be combined to obtain the required functionality. To demonstrate this, the following example describes how to implement hysteresis:

Imagine a logger monitoring temperature and being able to control a cooling system. When the temperature exceeds some threshold, the logger should turn the cooling system on until the temperature is lowered to some other threshold whereupon it will turn the cooling system off. The two thresholds provide the hysteresis to prevent the fan from being rapidly turned on and off. For this example the upper threshold is 55°C and the lower threshold 50°C.

Start by defining the threshold events:

Name	Description	Event	A	B
HT upper	High temp on	Channel A > B	Internal Temp	55
HT lower	High temp off	Channel A < B	Internal Temp	50

Next are the two events that reflect whether or not the logger is in the high temperature state:

Name	Description	Event	A	B
HT	High temp state	On Event A Until Event B	HT upper	HT lower
not HT	Not high temp	Not Event A	HT	

The “HT” event is true from the time the logger exceeds the “HT upper” threshold (55°C) until the time it falls below the “HT lower” threshold (50°C). In other words, it’s the “temperature is too hot and needs cooling” state. The “not HT” event is true whenever the “HT” is not true, i.e. when the system is not “too hot”.

If all you wanted to do was control a cooling system via relays, the above events are all you need. You would attach a latching relay to the logger (such as the 6525 relay control module), then add a "switch relay on" output to the "HT" event and a "switch relay off" output to the "not HT" event. There's no harm in the logger continuously sending "relay on/off" commands every scan those events are true.

What if you wanted to send an SMS alarm when the system got too hot? In that case sending multiple messages while the system stayed hot wouldn't be a good idea. To only send a message when the system flips from "temperature OK" to "too hot" requires a few more events:

Name	Description	Event	A	B
HT change	High temp state change	Delta Event A	HT	
HT begin	Enter high temp state	Event A AND Event B	HT	HT change
HT end	Leave high temp state	Event A AND Event B	not HT	HT change

The "HT change" event detects when the system is flipping between "temperature OK" and "too hot". It detects a change in either direction, but cannot by itself tell which direction the system is changing. To determine the direction a second event is needed.

The "HT begin" event detects when the system is going from "temperature OK" to "too hot". If the high temperature state has changed (the "HT change" event) AND the system is in the high temperature state (the "HT" event), then the system has just changed from "temperature OK" to "too hot".

The "HT end" event is similar to the "HT begin" event, except it detects the change from "too hot" to "temperature OK". It isn't needed if all you want to do is perform an action on the switch from "temperature OK" to "too hot".

To send an SMS when the system becomes hot, add the “SMS” instrument to the scheme, configure the message, then add the corresponding dialout group as the Output for the “HT begin” event.

Note that if all you wanted to do was send the message when the system became too hot, and didn’t need to worry about when it cooled down, you’d be able to discard the “not HT” event, leaving the following five events: “HT upper”, “HT lower”, “HT”, “HT change” and “HT begin”. If you DID want to send a “cooled down” message, then you’d leave in the “not HT” and “HT end” events, create a second message on the SMS instrument, then set the “HT end” output to activate that second dialout group.

To summarize:

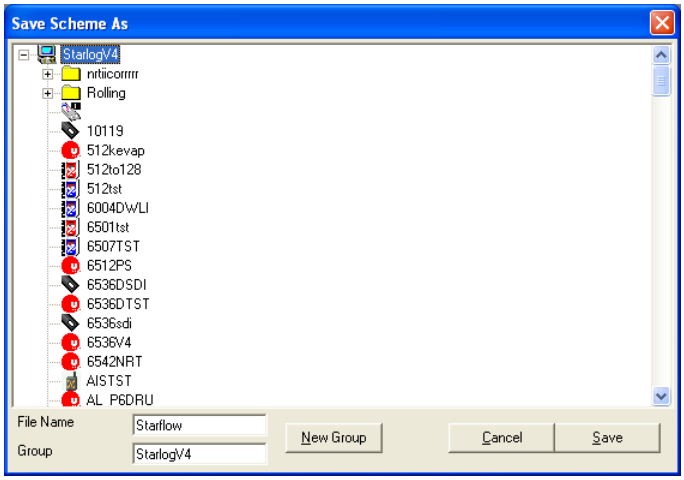
Name	Description	Event	A	B	Output
HT upper	High temp on	Channel A > B	Internal Temp	55	
HT lower	High temp off	Channel A < B	Internal Temp	50	
HT	High temp state	On Event A Until Event B	HT upper	HT lower	Cooling on
not HT	Not high temp	Not Event A	HT		Cooling off
HT change	High temp state change	Delta Event A	HT		
HT	Enter high temp	Event A AND	HT	HT	High temp

begin	state	Event B		change	SMS
HT end	Leave high temp state	Event A AND Event B	not HT	HT change	OK temp SMS

6.5 Saving the Scheme

To save your scheme, click the `Save` icon (shown to the right).

If you've saved your scheme before it will immediately save. If you've never saved the scheme before, the dialog shown below will appear. You can get the same dialog at any time by selecting `Save Scheme As` from the `File` menu.

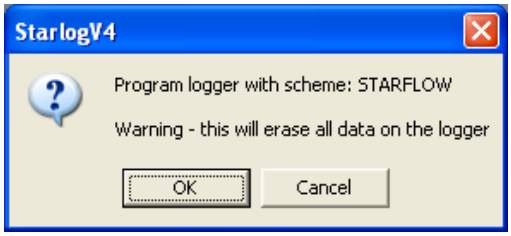


Enter the scheme name in the `File Name` field. There is a maximum length of eight characters.

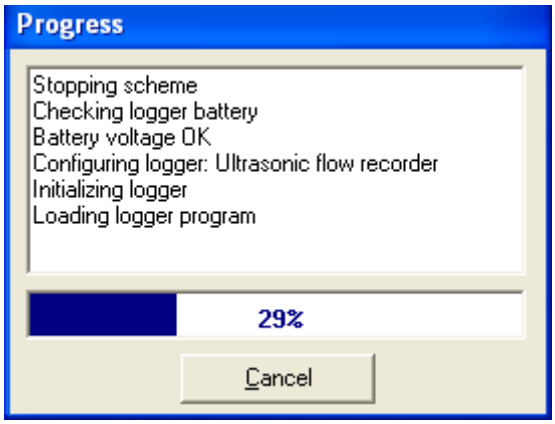
The `New Group` button allows you to create sub-folders of schemes. Groups may be created inside groups, too.

7.0 Programming Loggers

Loggers are programmed from the main screen, by clicking on the Program icon, shown to the right. You will be asked to confirm before the programming will proceed:



Clicking `OK` will open a new window that shows the progress of the programming:



If all goes well, a `Logger successfully re-programmed` message will appear (with `Disconnected` as the final message). Click `OK` to close the progress window.

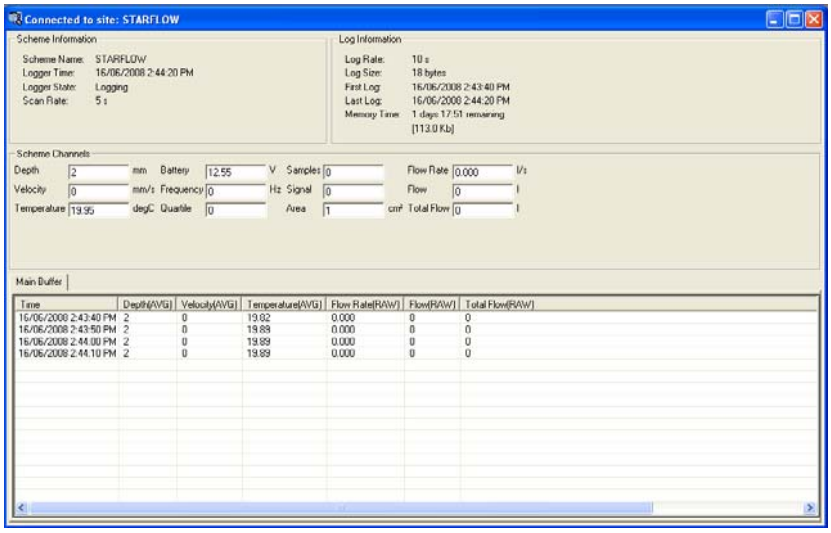
If Any errors are detected and reported on the computer screen. You may then correct them and Program STARFLOW again. Error messages are:

Error	Correction
Timeout on Prompt	Check that the cable is connected to the right communication port.
	Check that this port you are using is selected in the Communications window for this Scheme.
	Consult the computer's documentation to verify the port's designation.
Timeout on Output	Communications errors. STARFLOW not responding to request. Could be caused by a program running on your computer in the background. Check connections, halt other programs running on your computer, then try again.
Timeout on Input	
Logger will have powered down	
Extended error x	Error configuring STARFLOW. Write down the number, check connections, then try again. If unsuccessful, contact your nearest support centre.
Hex byte expected	Transmission errors. Non-fatal informative errors indicating a communication error has been detected. Check cabling or Modem's telecommunications line. The transmission is automatically retried and the system will proceed normally.
Bad Checksum	
<CR> expected	
Verify error	
File not found	Save the Scheme again (this generates files needed), or re-install STARFLOW Software.
Firmware insufficient	The Hardware chosen for the Scheme doesn't match STARFLOW. Re-create the Scheme using the correct STARFLOW model.
Modem Reports – No Carrier	The remote Modem not answering. Check phone number. Check that remote Modem is functioning.
Modem Reports – Busy	The remote Modem is off the hook. Wait, then try again.
Modem Reports – No Dial Tone	The Modem is not connected to the phone socket. Connect, then try again.

8.0 Test Mode

Test Mode is used to check the status of the logger, and to monitor its logging progress.

To enter Test Mode, click on its icon (shown to the right). A window similar to the following will appear:



The `Scheme Name` shows the name of the scheme that has been programmed into the logger. If the scheme in the logger isn't the same as the currently selected scheme, the following message will be displayed:

StarlogV4
Scheme on the logger doesn't match the loaded scheme
Load the scheme: "STARFLOW" to view test mode channels correctly
OK

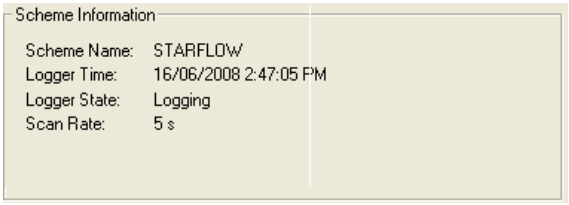
You should select the named scheme (in this case “Starflow”) and load its Test Display.

The Test Mode window is divided into four sections:

1. Scheme Information
2. Log Information
3. Scheme Channels
4. Log Buffers

Each of these items is explained in detail below.

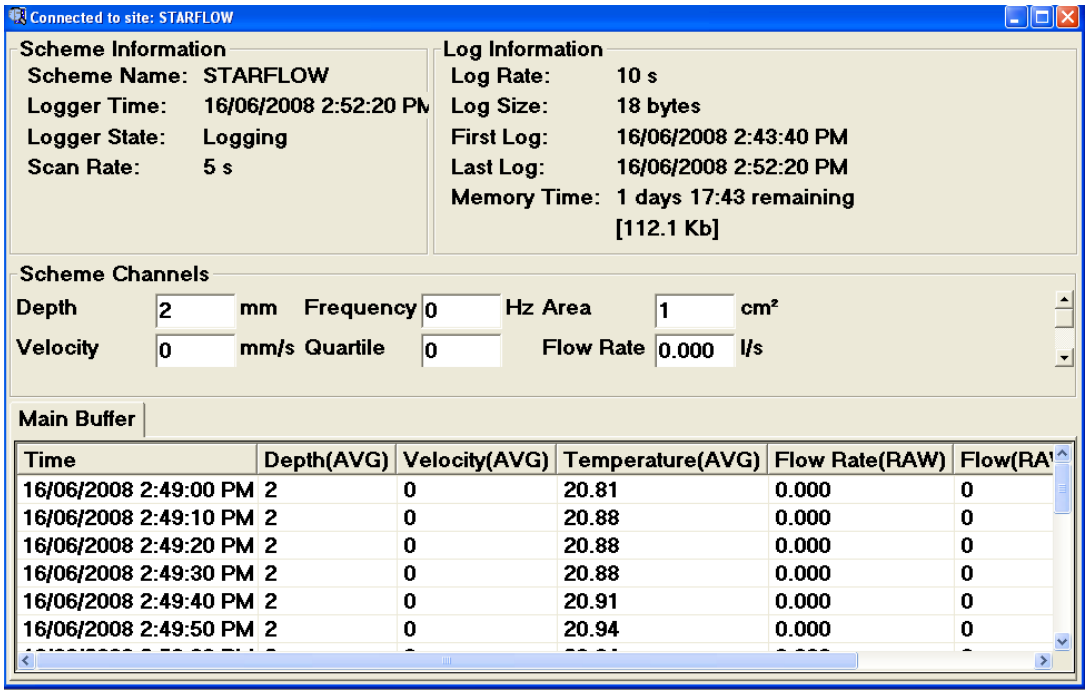
8.1 Scheme Information



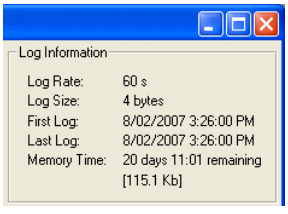
The Scheme Information section has the following items:

- **Scheme Name**: The name of the scheme programmed into the logger.
- **Logger Time**: The date/time of the logger.
- **Logger State**: One of `Primed`, `Logging`, or `Stopped`:
  1. **Primed**: The logger hasn’t yet started logging. Loggers with no built-in instruments (excluding internal battery and temperature sensors) will not start logging until three scans have passed since a plug was connected to their “Input Signals” connector.
  2. **Logging**: The logging is sampling and recording data.
  3. **Stopped**: The logger is not recording. This may be because the inputs have been unplugged, or the logger Main Buffer has filled (only applicable to Linear types, see *Other Buffer Settings* on page 62).
- **Scan Rate**: The time between consecutive samples of the inputs.

In this Test mode you can also increase the font to a larger size by pressing the (+) sign on your keypad, this is especially useful for field situations.


Connected to site: STARFLOW
Scheme Information
Scheme Name: STARFLOW
Logger Time: 16/06/2008 2:52:20 PM
Logger State: Logging
Scan Rate: 5 s
Log Information
Log Rate: 10 s
Log Size: 18 bytes
First Log: 16/06/2008 2:43:40 PM
Last Log: 16/06/2008 2:52:20 PM
Memory Time: 1 days 17:43 remaining
[112.1 Kb]
Scheme Channels
Depth 2 mm Frequency 0 Hz Area 1 cm²
Velocity 0 mm/s Quartile 0 Flow Rate 0.000 l/s
Main Buffer
Time Depth(AVG) Velocity(AVG) Temperature(AVG) Flow Rate(RAW) Flow(RA
16/06/2008 2:49:00 PM 2 0 20.81 0.000 0
16/06/2008 2:49:10 PM 2 0 20.88 0.000 0
16/06/2008 2:49:20 PM 2 0 20.88 0.000 0
16/06/2008 2:49:30 PM 2 0 20.88 0.000 0
16/06/2008 2:49:40 PM 2 0 20.91 0.000 0
16/06/2008 2:49:50 PM 2 0 20.94 0.000 0

8.2 Log Information

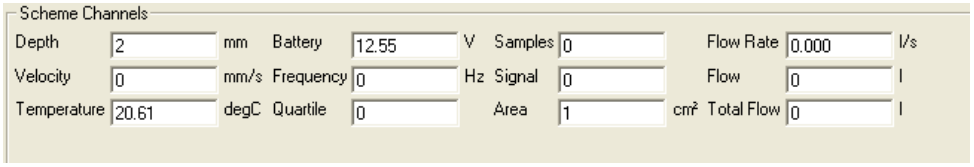

Log Information
Log Rate: 60 s
Log Size: 4 bytes
First Log: 8/02/2007 3:26:00 PM
Last Log: 8/02/2007 3:26:00 PM
Memory Time: 20 days 11:01 remaining
[115.1 Kb]

The Log Information section has the following items:

- **Log Rate**: This is the time between consecutive logs.

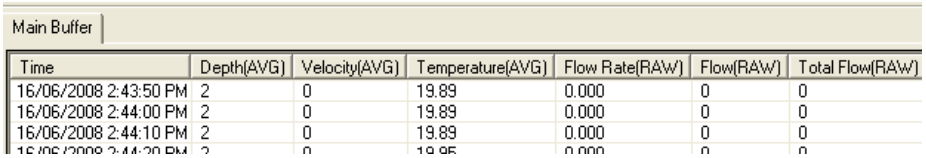
- **Log Size**: This is the size of each log entry in the Main Buffer in bytes.
- **First Log**: This is the date/time when the first log was recorded.
- **Last Log**: This is the date/time when the most recent log was recorded.
- **Memory Time**: This is the estimated time remaining until the Main Buffer fills up and either stops (Linear) or starts overwriting the oldest data (Circular). The Main Buffer free space is shown in square brackets after the time.

8.3 Scheme Channels



The Scheme Channels display the current readings of the instruments connected to the logger.

8.4 Log Buffers



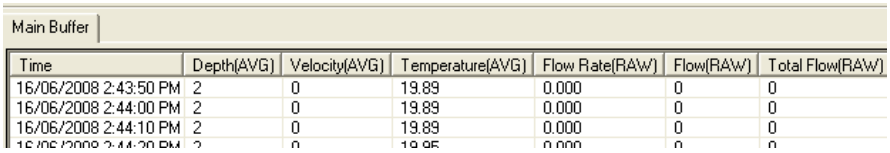
The Log Buffers are displayed across the bottom half of the window. The Main Buffer plus any Event Buffers are each given their own tab. Click on the tab to select the buffer to view.

Each buffer viewer operates in one of two modes:

- **Table**: This displays the logged data in tabular form.
- **Graph**: This display the logged data in a graphical form as a line plot of data. Each logged item forms a series and each can be individually turned on and off.

8.4.1 Log Buffer Table View

This is the default Log Buffer view. Each column is a different logged data item. Each row is a log record.

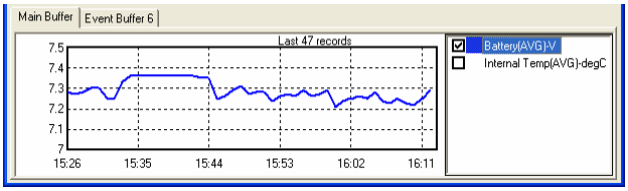


To change to the Graph view, right-click anywhere over the table data and select `Graph` from the menu.

To change the number of log records shown, right-click anywhere over the table data and select the required number of records from the `View` sub-menu. The data selected is always from the most recently logged records. Since 100 records is the largest number available, data logged more than 100 records ago cannot be viewed in Test Mode. You will have to unload the logger to see older data.

8.4.2 Log Buffer Graph View

The Graph View displays the logged data in the form of a series line plot. Each logged item forms a different series. The time of log is the X-axis, the Y-axis is the value of the logged items.



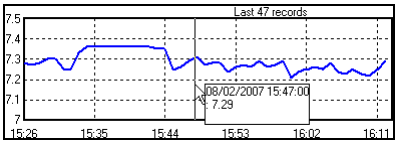
To change to the Table view, right-click anywhere **outside** the plot area (either of the axes or the `Last N records` title) and select `Table` from the menu.

To change the number of log records shown, right-click anywhere **outside** the plot area (either of the axes or the `Last N records` title) and select the required number of records from the `View` sub-menu. The data selected is always from the most recently logged records. Since 100 records is the largest number available, data logged more than 100 records ago cannot be viewed in Test Mode. You will have to unload the logger to see older data.

To adjust which data series are plotted, either use the checkboxes to the right of the plot area, or right-click in the plot area and select/deselect the series from the `Filter` sub-menu.

To see the specific value at a point on the graph, move the mouse over the graph and line up the vertical line that moves with the mouse pointer over the point of the graph that you're interested in. After a short delay a popup tooltip will appear showing the date/time and value of the data at that position.

The following shows that at 08/02/2007 15:47:00 a value of 7.29 was logged:



Note that the mouse doesn't have to be on the plotted line – any position vertically above or below, but inside the graph area, will work.

9.0 Unloading Data from Loggers

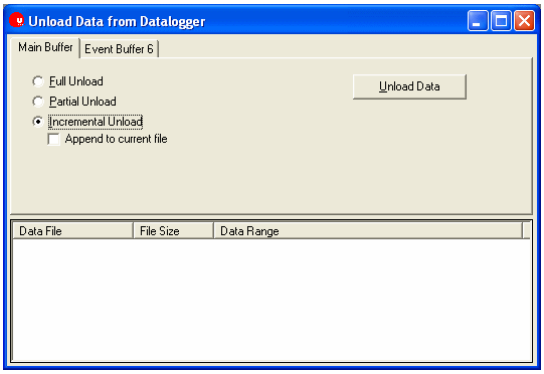
Once you've had your logger operating for a while, it will have recorded some data. Unloading is the action of copying the data stored in the data logger into a CSV (comma separated value) file on your computer.

CSV files can be directly opened in Excel, and are also a common format supported by other software such as Tideda and Hydsys.

Unloaded CSV data files are stored in a scheme sub-folder of the folder specified by the `Data Path` option for Version 4 schemes (see *Starlog V4 Options* on page 39), or the `Starlog V3 Data Path` option for Version 3 schemes (see *Starlog V3 Options* on page 40).

NOTE: Version 4 software can only produce CSV files, it cannot generate Version 3 compatible `*.Unn` files.

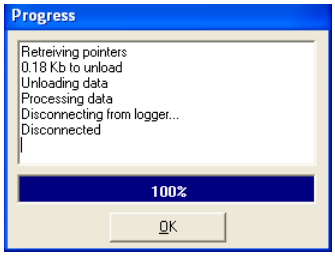
To unload logged data from your data logger to your PC, click on the `Unload` icon (shown to the right). The following window will appear:



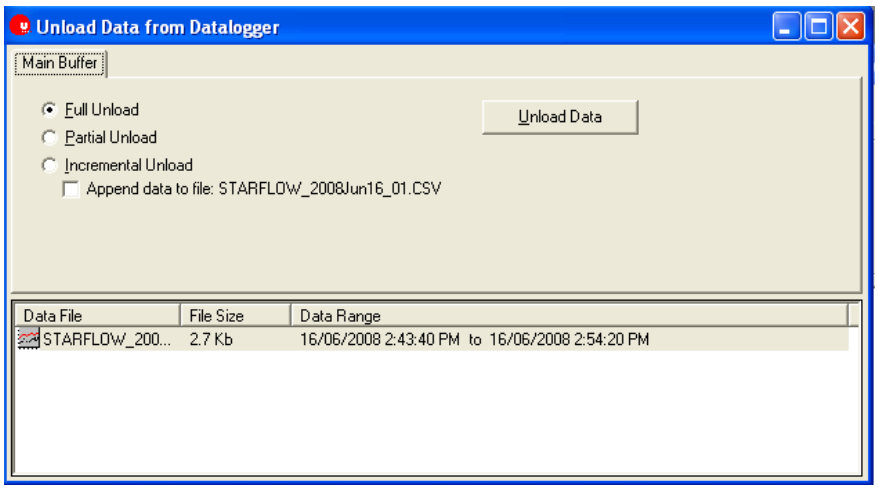
If your scheme has defined multiple buffers, you must unload each one in turn. There are three options for downloading each buffer:

1. **Full Unload**: This unloads all the data available on the logger into a new CSV file.
2. **Partial Unload**: For fixed log interval buffers, this unloads all the data between two dates into a new CSV file. For event-based buffers, this unloads a selectable number of log records, starting at the most recent.
3. **Incremental Unload**: This unloads all data logged since the last time you unloaded the logger. If you've never unloaded the logger since you programmed it, this will be a Full Unload. Tick the `Append to current file` checkbox if you want the data to be appended to the most recently unloaded data, otherwise the data will be stored in a new file.

When you have selected the unload method you want, click the `Unload Data` button. A window will appear showing you the progress of the unload:



When complete, the newly unloaded data will be added to the list of files:

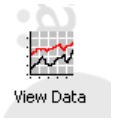


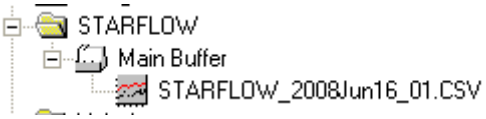
You can view a CSV file by double-clicking on it in the list. See *Viewing Data* on page 80 for a complete description of viewing logged data.

10.0 Viewing Data

Starlog is not data processing software. We recommend that you use Tideda, Hydsys, or Magpie to process data. The data viewer is for functional testing only.

To view data that you have previously unloaded, click the `View Data` icon (shown to the right). The following window will appear:





Initially, only the `Source Data File` tab is available. This is where you select the data you want to view.

10.1 Source Data File

Before selecting the file to view, you must first select the type of data you want to view. There are four supported types:

1. **StarlogV4 (*.CSV)**: Version 4 data files generated by version 4 software from version 4 schemes.
2. **StarlogV3 (*.CSV)**: Version 4 data files generated by version 4 software from version 3 schemes.
3. **StarlogV3 (*.Ann)**: Version 3 data files generated by version 3 software.
4. **Archive (*.CSV)**: Arbitrary CSV files.

NOTE: Version 4 cannot directly view Version 3 unload files. Before you can view Version 3 data, you must create `*.Ann` files for each `*.Unn` file using an ASCII report created in the Version 3 Report Editor.

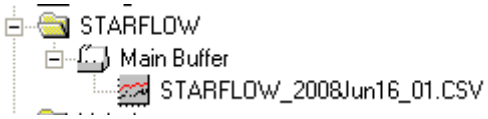
Selecting the type of data will change the tree of available files in the bottom of the window.

The first line of the window will show the folder that Starlog V4 is looking in for data files. In the sample screenshot above Starlog V4 is looking under `C:\Program Files\StarlogV4\DATA`.

10.1.1 Starlog V4 (.CSV) Files*

These files are grouped by scheme, each scheme will have one or more buffers, and each buffer will have its own set of logged data files.

The following screenshot shows that there is a scheme called `Starflow`, which has available data from its `Main Buffer`, and the only data file available is a file called `Demo_01.CSV`.



10.1.2 Archive (.CSV) Files*

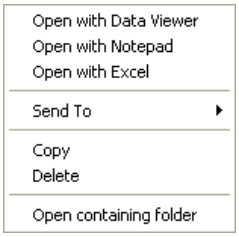
These are whatever CSV files Starlog V4 can find in the specified folder. CSV files to be viewed in the Data Viewer have some formatting requirements:

- The first line in the file assigns a name to each column consisting of the channel name and the logging method (raw, average, etc).
- The second line in the file assigns the units to each column (mm, degC, etc).
- The third line and beyond is the unloaded data.

10.2 Viewing the Data File

Once you've located the data file you want to view, there are a number of ways to open it:

- Double-click on it to open it using the Starlog V4 built-in Data Viewer (see ***Error! Reference source not found.*** below).
- Right-click on it to open a context menu:



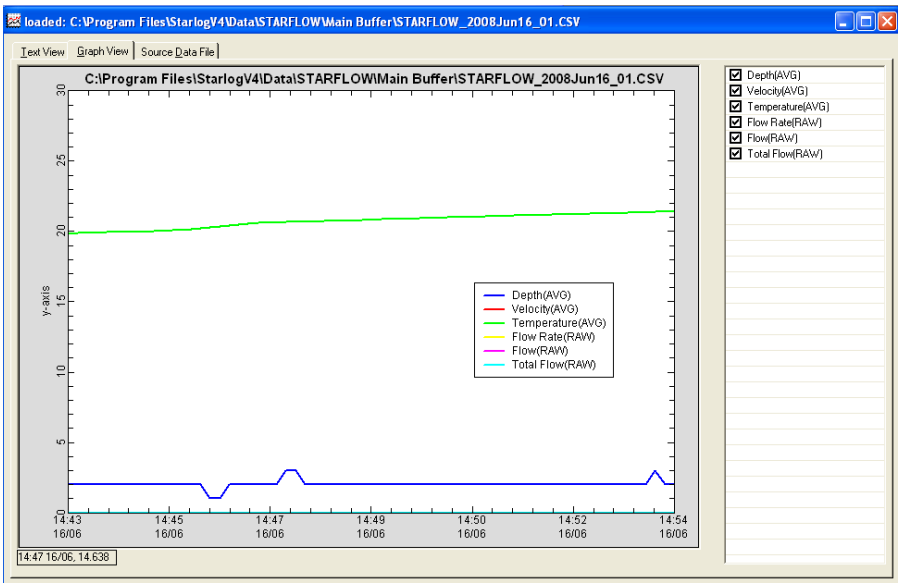
The "Open with" options are described below. The Send To, Copy, Delete, and Open containing folder are all handled exactly the same as when you right-click on a file in the standard Windows file Explorer.

10.2.1.1 Graph View

The default mode for viewing your data is the `Graph View`. This shows a zoomable graph on the left and individually selectable channels on the right. Untick or tick channels to hide or show them. The legend may be moved by dragging it to a new position.

The graph is zoomable by clicking and dragging out the rectangular area you want to zoom in to. Reset the zoom by right-clicking on the graph. The zoom level is also reset when you make a change to the visibility of any channel.

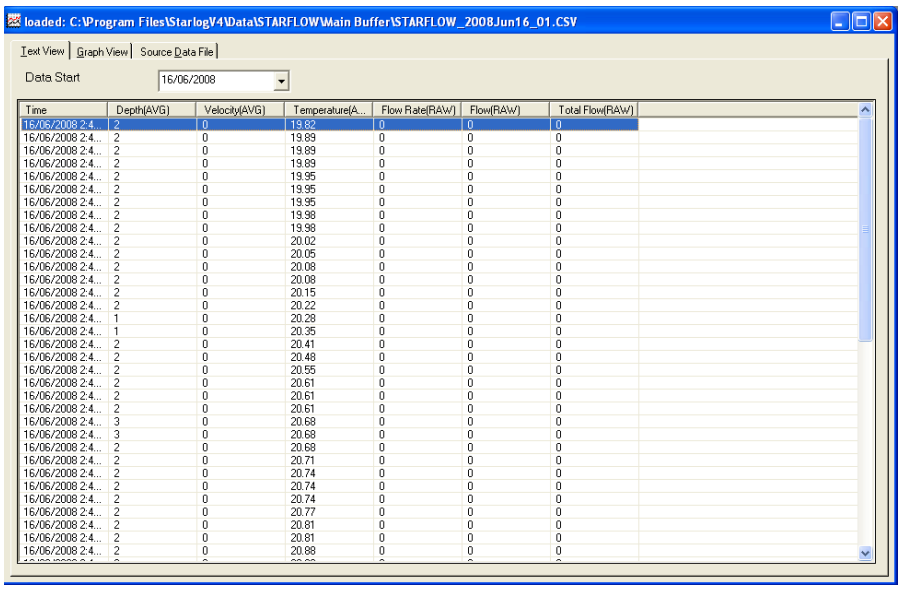
The example below has the Battery channel turned off, leaving the Internal Temp:



When you hover your mouse over the graph, the time of log of the data you're hovering is shown at the bottom left, next to the scrollbar.

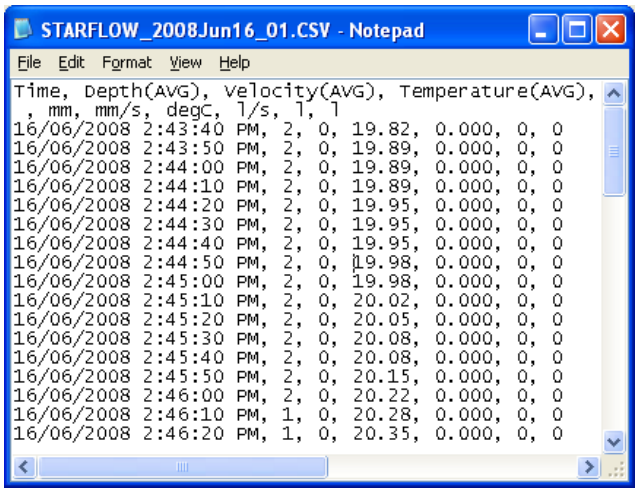
10.2.1.2 Text View

The `Text View` shows your logged data in a tabular form. The column widths are adjustable by dragging the divider between them. Use the scroll bar to select the data to view.



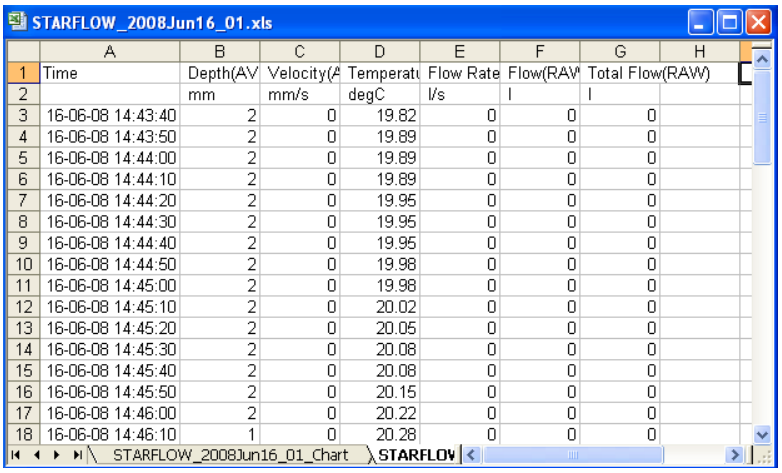
10.2.2 Opening with Notepad

Opening your data file in Notepad can be useful if you suspect some file corruption. Notepad doesn't try to interpret the data, so you can scan through it and manually correct any anomalies.



10.2.3 Opening with Excel

Opening your data in Excel gives you a lot more power to display, format, print, and analyse your data. When opened in Excel, two sheets are created; the first one is for viewing the data in a tabular format:

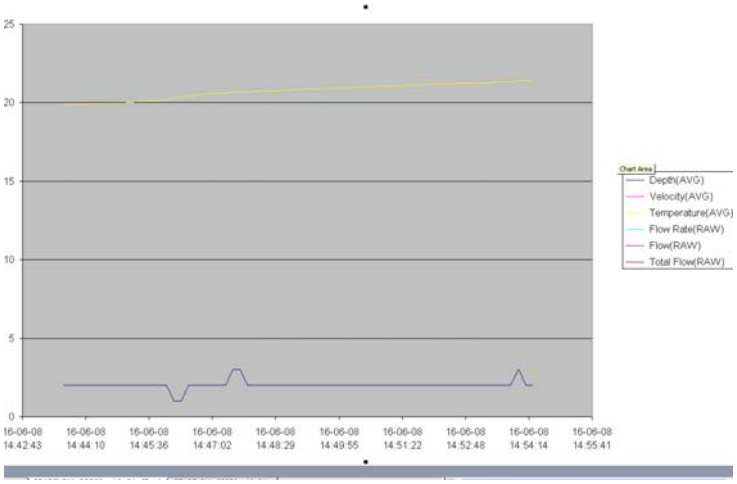


STARFLOW_2008Jun16_01.xls

	A	B	C	D	E	F	G	H
1	Time	Depth(AV	Velocity(A	Temperatu	Flow Rate	Flow(RAV	Total Flow(RAW)	
2		mm	mm/s	degC	l/s	l	l	
3	16-06-08 14:43:40	2	0	19.82	0	0	0	
4	16-06-08 14:43:50	2	0	19.89	0	0	0	
5	16-06-08 14:44:00	2	0	19.89	0	0	0	
6	16-06-08 14:44:10	2	0	19.89	0	0	0	
7	16-06-08 14:44:20	2	0	19.95	0	0	0	
8	16-06-08 14:44:30	2	0	19.95	0	0	0	
9	16-06-08 14:44:40	2	0	19.95	0	0	0	
10	16-06-08 14:44:50	2	0	19.98	0	0	0	
11	16-06-08 14:45:00	2	0	19.98	0	0	0	
12	16-06-08 14:45:10	2	0	20.02	0	0	0	
13	16-06-08 14:45:20	2	0	20.05	0	0	0	
14	16-06-08 14:45:30	2	0	20.08	0	0	0	
15	16-06-08 14:45:40	2	0	20.08	0	0	0	
16	16-06-08 14:45:50	2	0	20.15	0	0	0	
17	16-06-08 14:46:00	2	0	20.22	0	0	0	
18	16-06-08 14:46:10	1	0	20.28	0	0	0	

STARFLOW_2008Jun16_01_Chart | STARFLOW

There is also a second sheet called "*filename*_Chart" that displays the data as a graph:



11.0 Diagnostics

Diagnostics are accessed from the main Starlog V4 window by selecting the Diagnostics tab on the left toolbar. See the screenshot to the right:

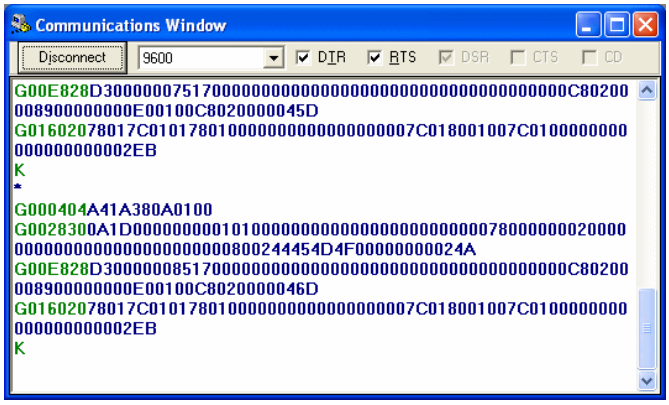
Diagnostics provides several functions to assist you with various problems you may encounter using data loggers. Each function is explained below:

11.1 Comms Window

The `Comms Window` function allows you to watch the communications between your PC and your data logger. You can watch the progress of

logger programming or unloading, or you can watch the commands issued during the test display.

The `Comms Window` is frequently useful for diagnosing modem problems and logger baud rate mismatches.



Data sent from the PC to the logger is shown in green, while data sent from the logger to the PC is shown in blue. The above screenshot shows communications that result from a typical test display. If no communication was taking place, you'd just expect to see regular star (asterisk '*') prompts from the logger.

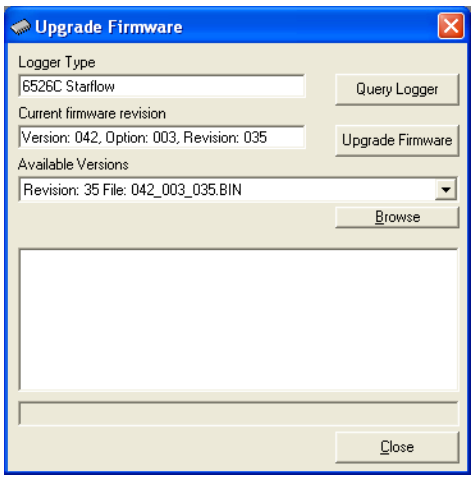
The top of the window lets you control the serial port, and provides some status indicators:

- **Connect/Disconnect**: Click to connect/disconnect to/from the serial port.
- **Baud rate**: The baud rate to use. If no star prompts are detected, the software will automatically cycle through all the baud rates until a star prompt is detected.
- **DTR**: Controls the Data Terminal Ready signal. Modems require this signal to be on (ticked) to enable dialling out to other modems.
- **RTS**: Controls the Request To Send signal. Unidata data loggers require this signal to be on (ticked) to wake up for communication.
- **DSR**: Indicates the current state of the Data Set Ready signal. The DSR state usually reflects the DTR signal.
- **CTS**: Indicates the current state of the Clear To Send signal. The CTS state usually reflects the RTS signal.
- **CD**: Indicates the current state of the Carrier Detect signal. Modems turn this signal on when they are connected to another modem.

11.2 Upgrade Firmware

The `Upgrade Firmware` function allows you to upgrade the internal firmware of most Unidata data loggers.

Click the `Query Logger` button to have the software determine what type of logger is currently connected, and what version of firmware it is currently running. The following screenshot shows the results of querying a Yellow Memory Card Starlogger:



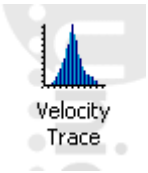
- **Logger Type**: Shows the logger type identified by the Query Logger function.
- **Current firmware revision**: Shows the firmware version currently programmed in the connected data logger.
- **Available Versions**: Lists all the firmware available to the Starlog software that is compatible with the connected data logger. You may click the `Browse` button to manually select an unlisted firmware, but updating a logger with unlisted firmware may make the logger unusable or even damage it!
- **Query Logger**: Automatically identifies the logger connected to the PC.
- **Upgrade Firmware**: Click to upgrade the connected data logger to the firmware selected in the Available Versions field. The window will indicate the progress of the upgrade.

11.3 SDI-12 Test

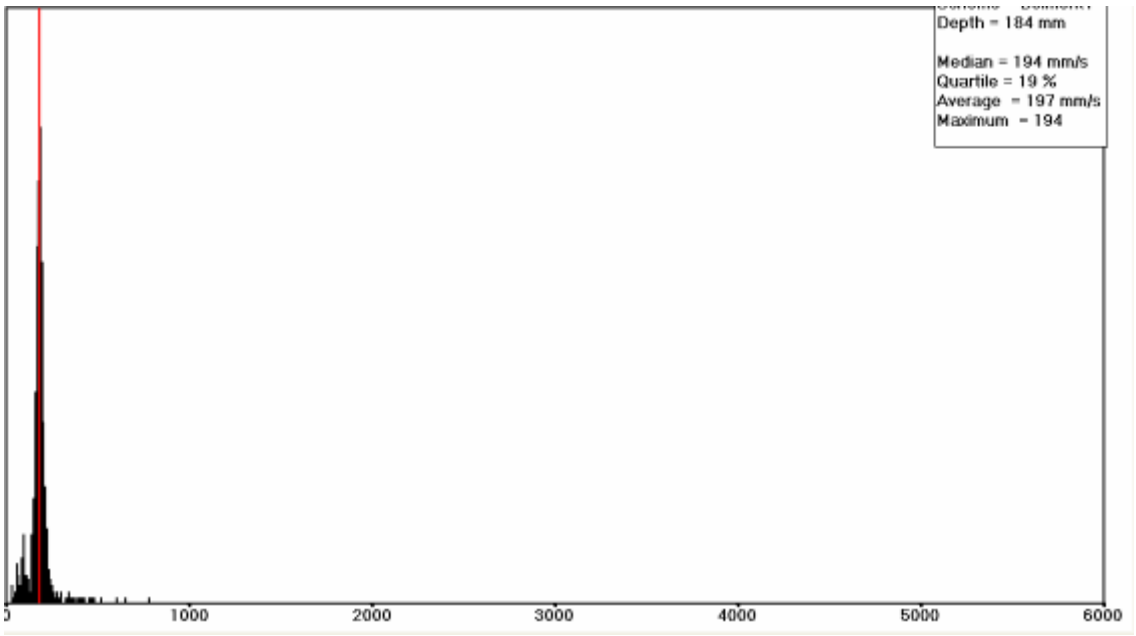
The `SDI-12 Test` function allows you to check the operation of the Starflow as an SDI-12 recorder and the operation if it is being used as an SDI-12 sensor such as a Starflow instrument connected to an external logger.This is explained in more detail on page 87.

11.3.1 Velocity Trace

This facility helps you to learn more about using STARFLOW for flow measurement. It lets you look at the velocity data the STARFLOW is recording and to experiment with ways of improving the signal. See *Velocity Histograms* beginning on page 87 for details on velocity trace histograms.



This program displays as a histogram the velocities collected during each measuring cycle. It lets you observe the “shape” of the signal and review a “mean” velocity calculated in several ways. Using this you may carry out tests and experiments in various flow environments.



12.0 Velocity Histograms

The Velocity Histograms that you will see by using Velocity Trace from the Control Panel are the STARFLOW's view of the channel. It is the composite of a range of factors including both characteristics of the equipment, the sampling method and the velocity dynamics within the channel.

The following statistics are computed from the range of doppler shifts measured for each cycle.

MEDIAN: The computed median of all the doppler shifts detected. Measured in mm/sec. This is the value presently logged.

QUARTILE: A ratio of the width of the peak to the height. This can provide an indication of the "quality" of the histogram. 20% to 50% are typical values. A transducer buried in sand will give 100% to 200%

AVERAGE: The mathematical average of all measured velocities, in mm/s. This can be unacceptably biased by signal noise.

NUMBER OF SAMPLES: The actual number of doppler shifts/samples collected and shown in the displayed histogram.

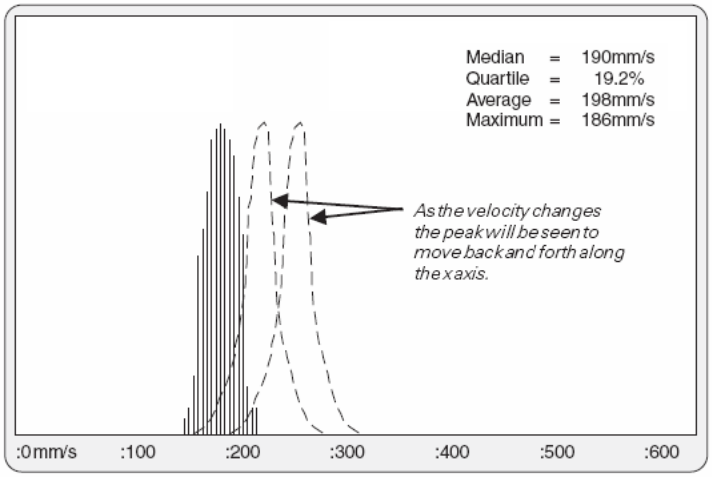
MAXIMUM: The doppler shift of the peak of the histogram, in mm/s.

The screen will cycle, refreshing the plot and summaries each time a new set of samples are acquired.

The x axis is scaled to 6000 mm/s.

The following examples are shown as you would see them on your screen.

An ideal signal when presented as a histogram appears as a symmetrical peak. The x axis represents the velocity in mm/sec. The y axis indicates the relative number of times a particular velocity has been received. The approximate “centre” of this peak is the value of the velocity we are looking for, as it will be the mean of all the echoes received.

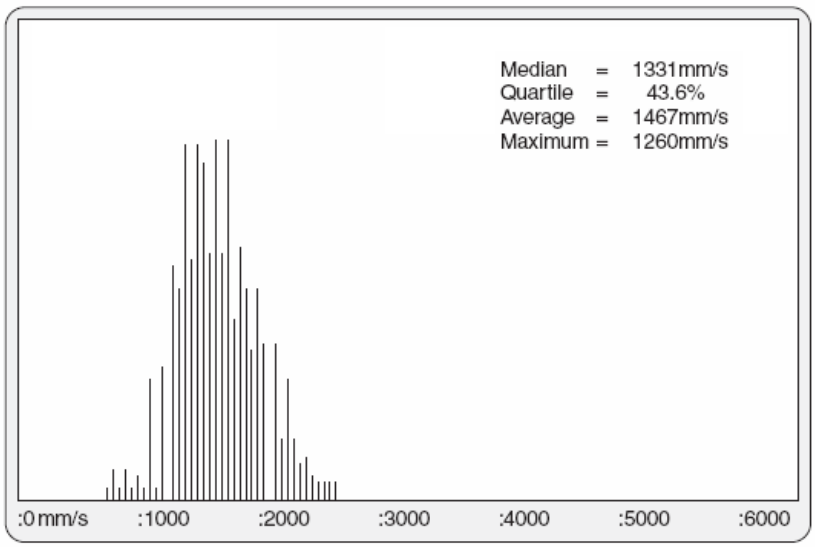


As the velocity changes the peak will be seen to move back and forth along the x axis.

- Note that Velocity Trace does not indicate Flow Direction, only Velocity magnitude.

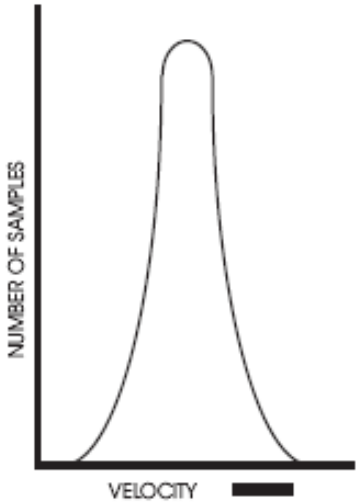
The width of the peak indicates that a range of velocities is being measured with each reading. The narrowest of peaks would be obtained in the ideal conditions of perfectly laminar, tranquil flows in water with an even distribution of reflective particles. These would still be 50—100 mm/sec wide and would appear as above.

In fast turbulent water the peak can be 500 mm/sec or more wide because of the range of velocities present in eddies and swirls. The following histogram is typical.



12.1 Inherent Factors In Doppler Histograms

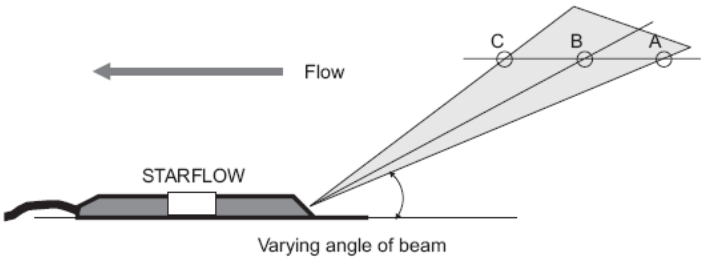
The width and shape of the peak displayed is caused by a range of factors all of which are measured by the doppler as a frequency shift. Some of these factors are inherent in the method.



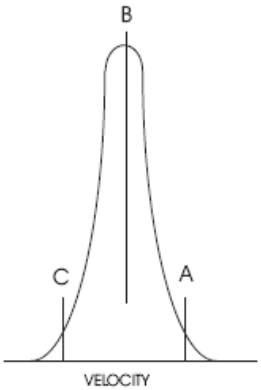
In flowing channels there are always a range of different velocities present but even in "perfect" conditions, with all water flowing at the same velocity the histogram displayed will still have a characteristic "skinny bell" shape. This is a composite of a variety of effects related to using Dopplers to measure water velocity in streams.

12.1.1 Varying Angle as Particles Pass Through the Main Beam

The acoustic beam has a width, or spread, of about 10°. The centreline of the beam is aligned at 30° above horizontal but as a particle passes horizontally through, the actual angle within the beam varies from 25° to 35°.



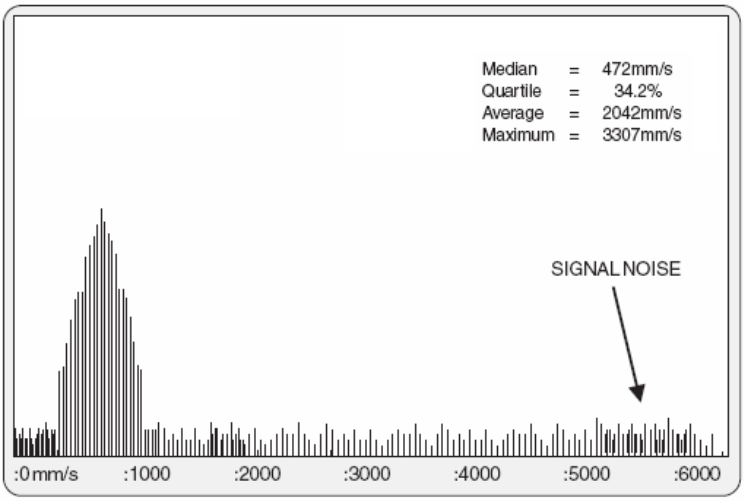
The doppler shift measured is the velocity component along the line between the particle and the transmitter, so this changes _5% as the particle traverses the beam.



12.1.2 Measuring Errors Due To "Signal Noise"

"Signal Noise" is a convenient term used to classify any Doppler shifts that can not be explained as legitimate measurements of water velocity. The STARFLOW is measuring tiny signals echoed back from small particles along a path scattered with many other particles, all in motion. The returned signals are sometimes echoes of echoes, vague and ambiguous and can be misinterpreted by the measuring circuits resulting in an incorrect Doppler shift.

These result in frequency shifts being measured that are outside the range of velocities expected. They can represent several percent of measurements in a scan but are typically widely distributed. They are usually statistically irrelevant because of the signal analysis techniques used to define the median.



12.2 Channel Characteristics Affecting The Signal

All signals are affected by the factors discussed above. Additional factors related to channel and flow characteristics can influence the measured velocity. These result in a widening of the histogram base because of the broader spread of Doppler shifts measured.

In a channel with laminar flows the shape of the peak remains symmetrical. If other factors disturb the velocity profiles within the field of view of the STARFLOW, the histogram may become distorted. This may introduce a bias to the computed velocity.

If the shape of the histogram is the same from cycle to cycle then it represents the STARFLOW view of the channel and not some transient aberration. Hydrographers have to decide if this represents a valid velocity measurement, or if the site is unsuitable.

12.2.1 The Nature and Location of the "Reflectors" in the Water

The STARFLOW measures echoed Doppler shifts from anything that is acoustically reflective and in the signal beam. It can not discriminate where the echo is coming from and the bigger, closer reflectors will generate a stronger signal than smaller or more distant reflectors.

Reflectors can include:

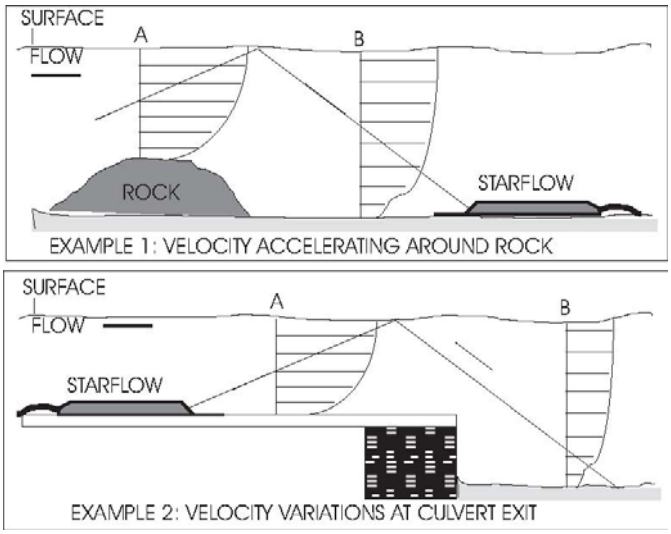
- All types of particles in suspension.
- Alluvial saltation load such as sand, pebbles and rocks moving at or near the bed.
- Leaves, sticks, and organic material.
- Surface waves from wind or velocity.
- Bubbles and entrapped air pockets.

During the time it takes to traverse the signal beam a particularly good reflector can be measured 100 or more times. The velocity of this reflector may bias or dominate one velocity measurement. This will tend to be averaged out during the logging period if it only happens occasionally.

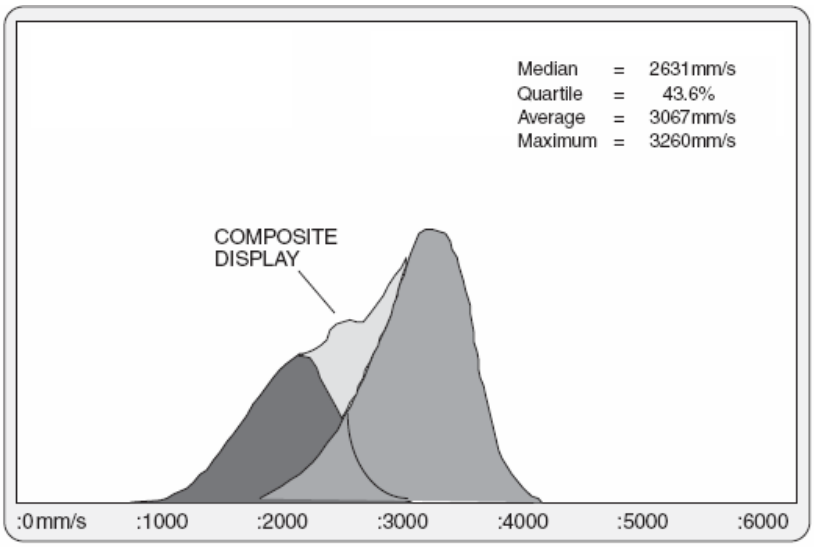
If it happens consistently it is a site characteristic. The relevance of this to the mean channel velocity will need to be understood and compensated for in processing.

12.2.2 Velocity Variations Due to Cross-Section Changes

If changes to the channel cross section introduce different velocity regimes within the view of the STARFLOW, the histogram is distorted. At low flows in clean streams, the beam can be reflected for some distance, and "see" unexpected velocities from some distance away.



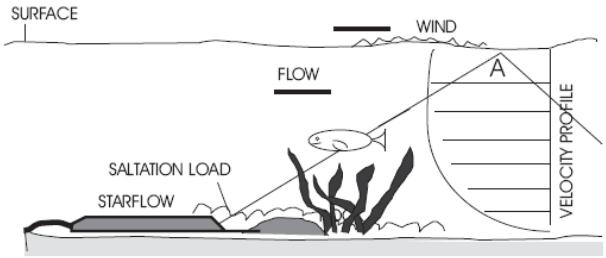
Higher velocities could also be seen at localised parts of the channel where water is accelerating around obstacles, or still carrying the effects of upstream higher velocities.



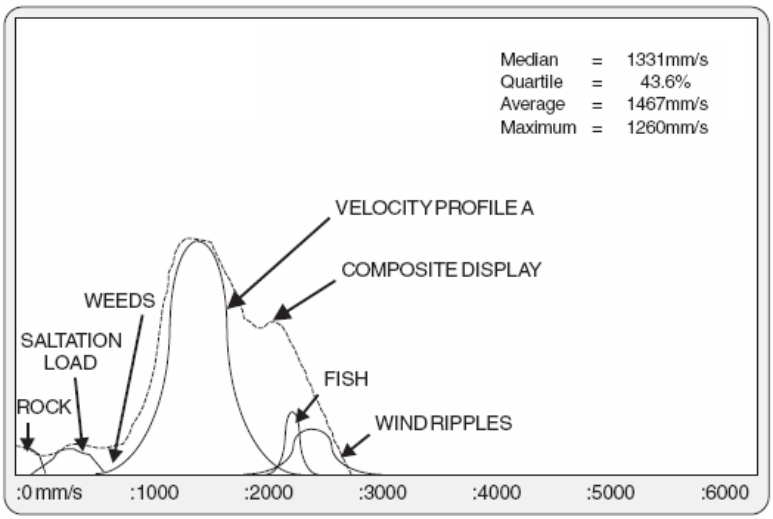
12.2.3 Measuring Unexpected Velocities

In some cases signals are from the wrong targets. A waving weed, aquatic animals, a strong stationary reflector in the bed, slow moving saltation targets or ripples on the surface can all produce doppler shifts that are not directly related to the water velocity.

The “field of view” of the STARFLOW can extend for at least 1m along the beam in clean water and reduces as the sediment load of the stream increases.

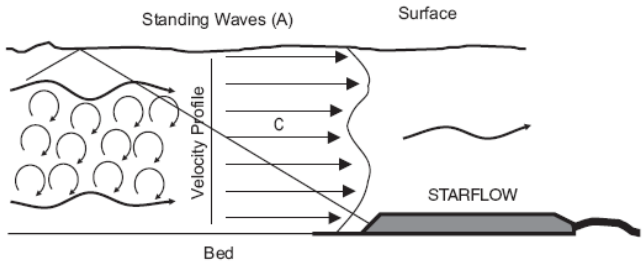


The beam can reflect from the surface underside and can detect different velocities to those expected. This results in a distorted peak, or a double or multiple peak in some situations, the composite of all velocities seen along the path. Such sites may not be suitable for the STARFLOW as the flow is not laminar.

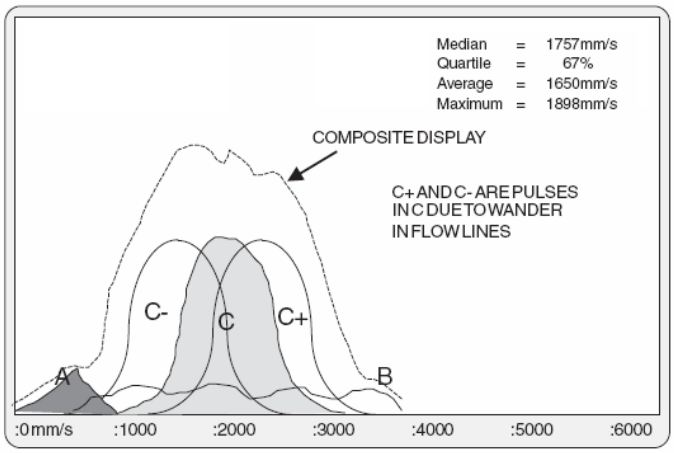


Measuring Turbulent Velocities

In higher bedslope streams a wide and multiple peak may be displayed



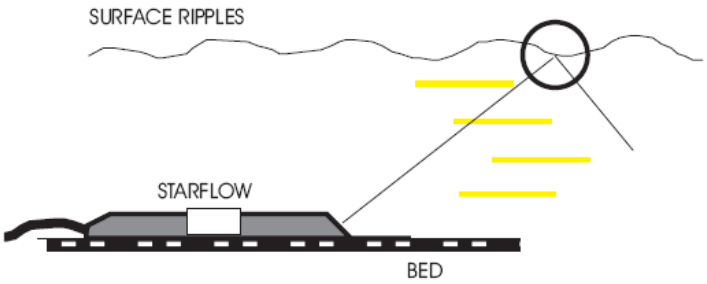
because of the complex moving landscape presented to the STARFLOW. The fact that many repeats of similar velocity histograms are seen indicates that the different velocity components seen are valid. How to interpret such signals is the issue.



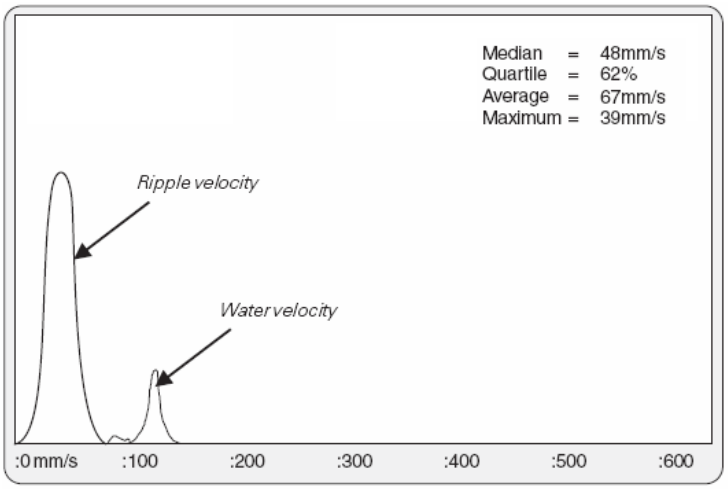
12.2.4 Effects of Surface Ripples

In shallow water the presence of ripples or small waves on the surface can cause complications. The ripples may be caused by wind, or be a feature of the channel caused by obstructions in the channel or by irregularities on the bank. Ripples will be moving and at a different velocity to the water.

In shallow and clean water the STARFLOW can clearly see the surface. As the ripples move they present a varying effect on the Doppler signal. At times the ripples will be positioned so that the carrier reflects away from the STARFLOW. A minor signal is detected but many more signals are detected from the water and a correct velocity is measured.



When the ripples move slightly one can become positioned such that it becomes an “acoustic mirror” reflecting back a powerful signal and dominating the signals form the channel. The median velocity will be biased toward the ripple velocity and will be incorrect.



In practice, a series of histograms in such a situation will move back and forth between the two extreme conditions, logging an average that is not the correct velocity. At some sites ripples will be a characteristic at certain levels. Positioning and orienting the STARFLOW so that it does not point directly into a “mirror” ripple face is the best prevention.

12.2.5 Measuring Flows in Very Small Channels

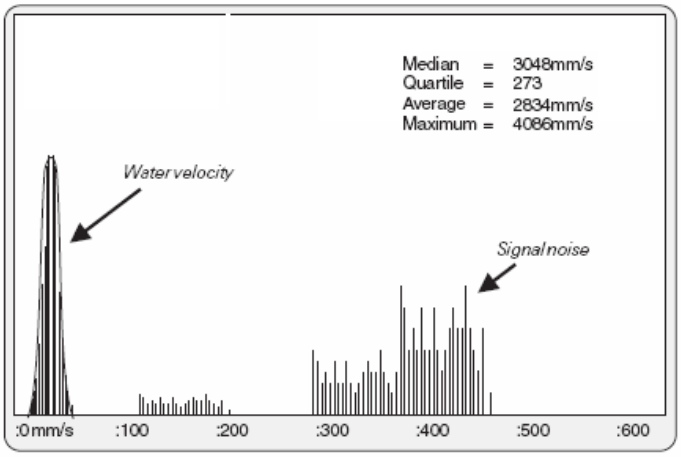
The STARFLOW can be installed in channels as narrow as 75mm. It can measure minimum velocities to 21mm/second in depths as low as 25mm. This flow rate is well below the measuring ability of most instruments, flumes or weirs. However the STARFLOW may struggle to operate correctly in these extreme conditions. The following conditions may be seen.

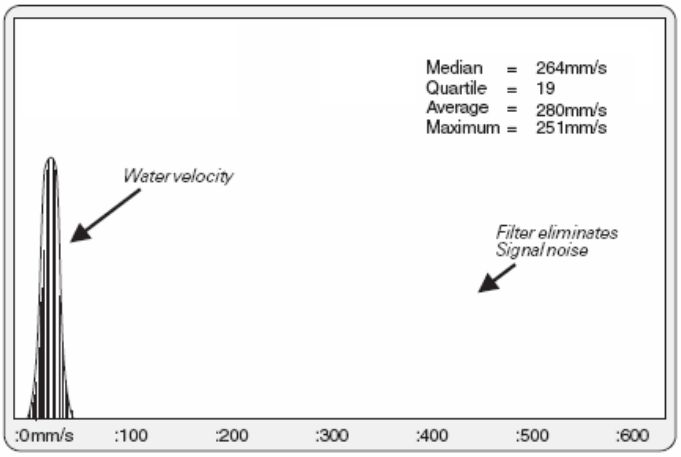
- The number of samples will be reduced. As velocities slow it takes the STARFLOW longer to measure each Doppler shift. At shallow depths the volume of water from which to acquire signals is reduced. These factors combine to mean the STARFLOW will generally not be able to acquire the full number of samples within the time allowed in a cycle. However, unless the water is extremely clean it will normally acquire enough signals for a sensible result.
- There will be an increase in the “signal noise”. Because of the difficult environment there will be an increase in very high velocity signals. This can bias most Doppler data beyond the ability of the signal analysis process to extract meaningful velocities. Logged data will jump between the correct value around 3m/sec.

  These can be overcome by the use of a dynamic filter that can be enabled in the STARFLOW configuration to minimise the impact of signal noise. The level below which the filter is active can be set during the preparation of the STARFLOW for a site. Setting this level near the maximum STARFLOW velocity will result in the filter always operating. This should not be done at sites where legitimate high velocities are experienced as the filter may affect the results.

Effects of Filter on Low Velocity Signal in Shallow Water

Developments are continuing to improve the integrity of low velocity measurements. Software enhancements can be loaded into existing units. Hardware changes will be incorporated into future units.

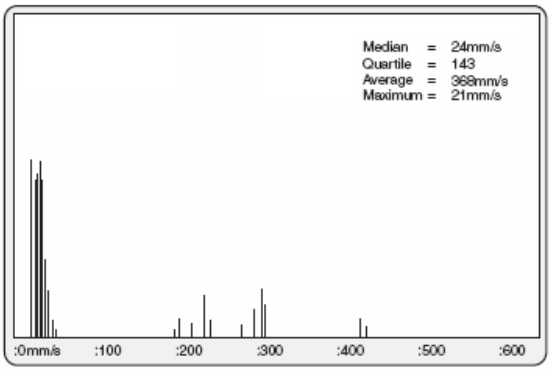




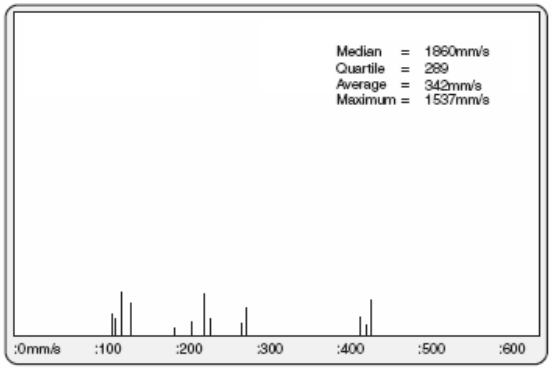
12.2.6 Velocities Too Slow to Measure

When velocities fall below the minimum level the Doppler can measure (21mm/sec) signals are not processed. However, under certain conditions signal noise is processed, a messy signal interpreted and a higher velocity results. Usually the processed quartile is too large. Using the filter will prevent most of these signals.

- **Very Slow Velocities, Below the Measuring Threshold**



Legitimate velocity: some noise



Velocity too slow: only noise remianing

12.2.7 Measuring Velocities in Very Shallow Water

Poor quality velocity data will result if the water becomes so shallow that the top of the eyes of the transducer come out of the water. A configuration setting can be used to switch off the velocity operation of the STARFLOW when measured depth is so shallow that the eyes are exposed. The Velocity Trace display will be similar to that for very slow velocities.

The depth transducer will measure depths down to about 5mm. If it is important that these very low flows be measured, then the STARFLOW can be fitted into a narrow channel or recessed into the bed such that all the STARFLOW is underwater whenever flow occurs.

12.2.8 Interference to the Transducers

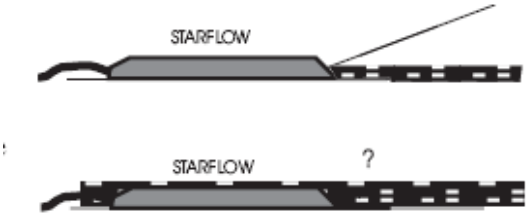
It is inevitable that bed mounted instruments will become layered with silt or algae. They may sometimes be affected by siltation or debris. The following effects have been noticed.

12.2.9 Silt, Algae and Other Soft, Saturated Materials

When covering the transducers with a 1-2mm thick layer, appear to have little effect on the signals logged. Provided the material is flexible and saturated the ultrasonic signals can be transmitted and received through it.

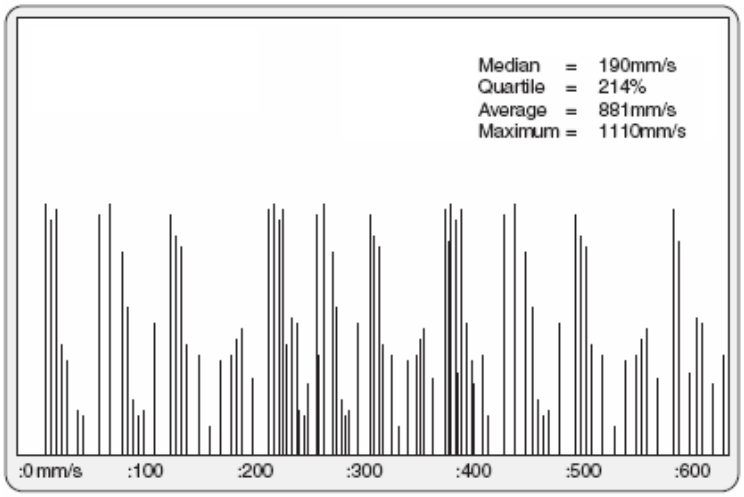
12.2.10 Burying the Transducer in Sand

Part buried sensors continue to operate. Provided some part of both velocity sensors are above the sand level the velocity recorded is the same as if the sensor was clear.



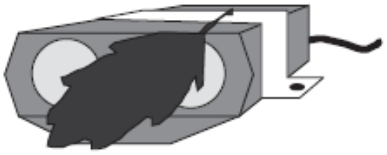
Completely buried sensors result in the signal collapsing. The signal does not appear to escape from beneath the sand to interrogate the water above.

The following histogram is typically seen. Note that the Quartile is reporting 214%, indicating that the spread of Doppler shifts is very wide and there is little consistency in shifts detected.



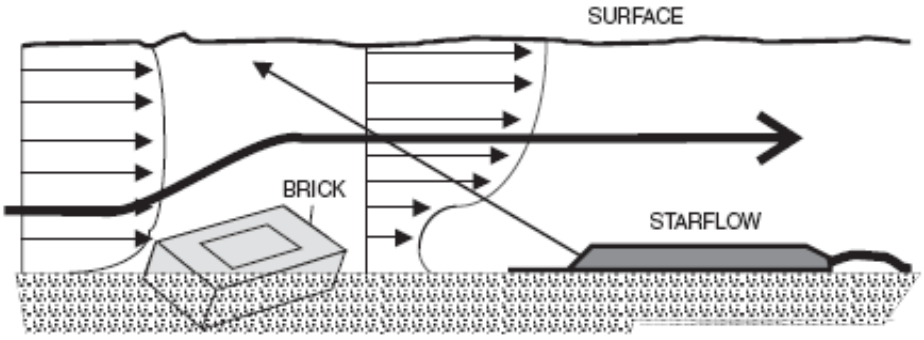
12.2.11 Debris on the Sensors

A similar effect to saltation can result from leaves and fine debris covering the sensors.
If the sensors are partly clear the recording is not effected. However one leaf lying across the two velocity sensors is enough to corrupt the signals and produce the type of histogram produced from a buried sensor.



12.2.12 Disruption of the Flow Pattern by Debris

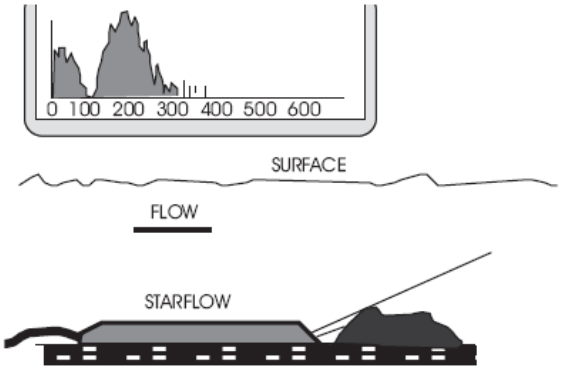
Larger debris in the vicinity may affect the logged values by changing the velocity distribution in the field of view of the sensor.



The flow distribution in the channel may no longer be laminar and the relationship between the logged and mean channel velocity may be distorted. The histogram produced appears similar to those described under *Measuring Unexpected Velocities* and *Measuring Turbulent Velocities* on pages 96 and 98.

12.2.13 Blocking of the Signal Paths by Objects

One strategically placed solid object, such as a rock, stick or other acoustically opaque material, may block the path to either sensor blanketing any signals. There will be a dominance of zero signals however those below 20 mm/sec. are discarded. The histogram will be distorted and have a characteristic vertical face at 20 mm/sec.



Flow Measurement Extensions

STARFLOW is able to perform a wide range of flow calculations. This enables STARFLOW to be used in partly filled circular pipes, regular open channels and natural streams.

Other closed shapes such as ovoid pipes, require a user-defined Area Rating Table .

Terms

Area (A):	(cross section) Calculated by STARFLOW from the Area Rating Table using the measured depth. Units = cm2 or dm2 or m2.
Area Rating Table:	Look-up table of depth versus cross-sectional area of the channel being measured.
Depth (D):	Water depth above the STARFLOW unit. Units = mm.
Velocity (V):	Average (median) velocity of water in the channel measured by STARFLOW. Units = mm/s.
Scan Rate (SR):	Frequency of STARFLOW measurement cycle (Default = 60 secs). Units = second.
Log Interval:	Frequency of STARFLOW recordings. (Default = 15 minute). Units = scans
Flow Rate (FR):	Instantaneous Flow Rate, calculated by STARFLOW as the product of Velocity and Area. Units = l/s or kl/s or Ml/s. *FR V A*
Flow (F):	Flow volume each scan interval calculated by STARFLOW as the product of the Flow Rate and the measurement interval (Scan Rate). Units = l or kl or Ml *F FR SR*
Total Flow (TF):	Totalised Flow Volume. Units = l or kl or Ml *TF F*

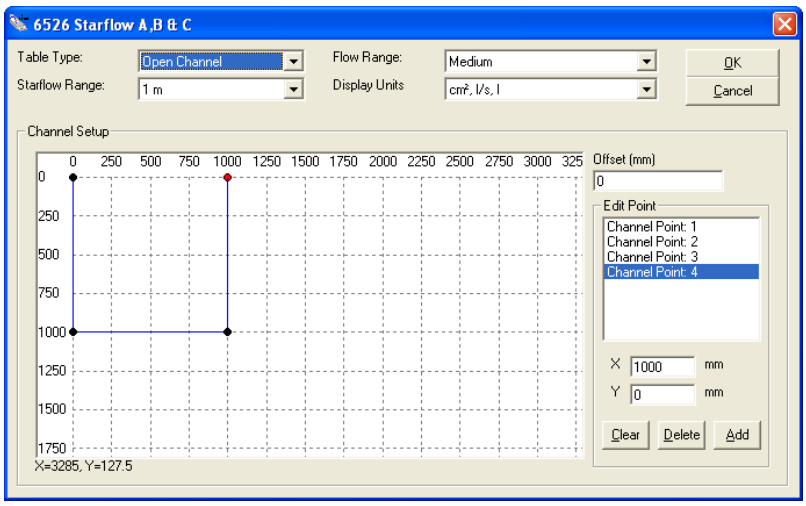
12.3 Overview Of Creating A Flow Scheme

Creating a STARFLOW Scheme for flow measurement is a five-step process:

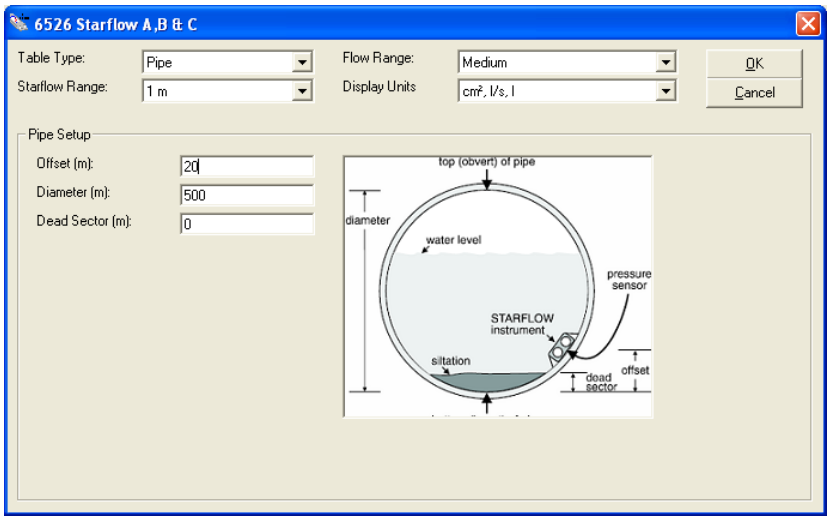
1 Determine the dimensions of the channel.

2 For open channels create a Cross-Sectional Area in the Flow extension instrument which has already been added in the scheme editor and enter the parameters of your channel. Points can be added and deleted, also note that the Starflow range should be selected, this will be written on the front of the Starflow.

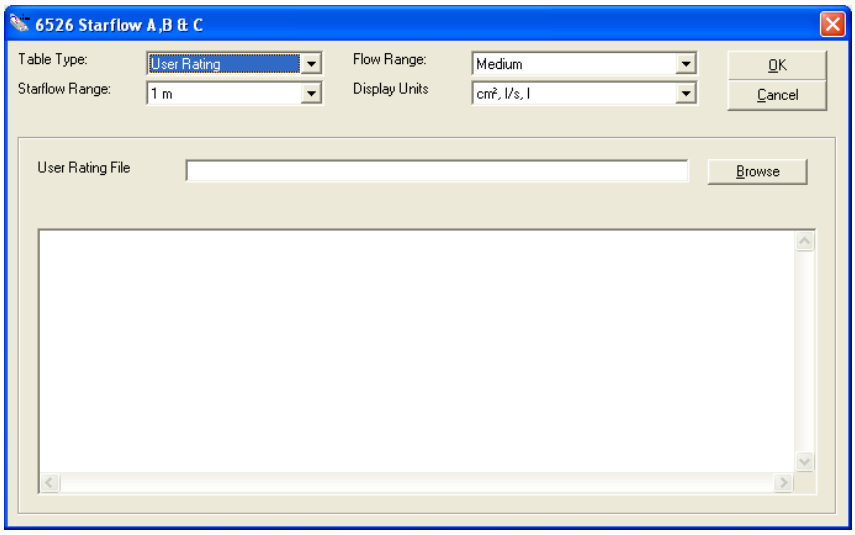
If your water depth will always be below 1m it is advisable to choose the 1m range.



3 The table type can also be a pipe; in this situation the pipe dimensions should be entered.



4 In the case of a User Defined Area Rating Table, select the text file to be used.



6 Once this has been completed then Save the Scheme.

Creating an Area Rating Table

To calculate Flow, STARFLOW uses a lookup table called the Area Rating Table. The Area Rating Table is automatically generated when the scheme is saved from information provided in the Flow extension instrument.

An Area Rating Table is created for each scheme. This table is generated by one of three methods depending on the STARFLOW site.

Type	STARFLOW Site	How Created
Pipe	Partially filled circular pipe	Enter offset, diameter and dead sector in Area Rating Table window.
Open Channel	Open channel and natural stream	Entering the correct dimensions in the flow extension instrument
User Defined	Other closed-in shapes, like an ovoid pipe	Create a text file listing measurements. Nominate this file in the scheme's User Rating file.

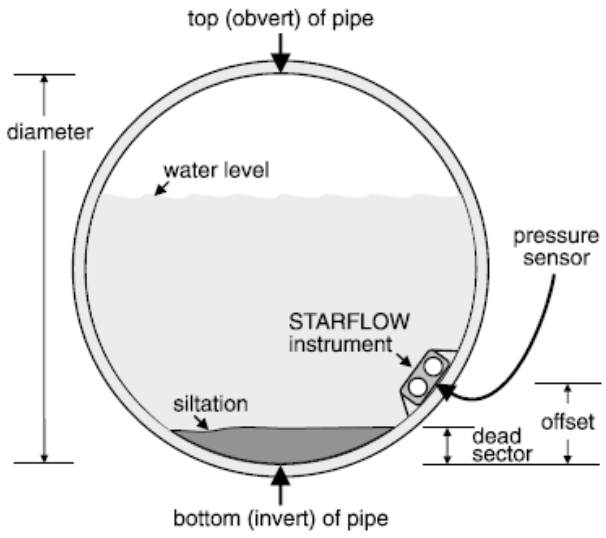
Partially Filled Pipe

There are four parameters needed to define a pipe installation.

Range (m) – Depth range of STARFLOW. This defines the depth range able to be measured by the STARFLOW. There are two ranges: 2m and 5m although if the depth will never be above the 1m range this should be selected for greater precision.

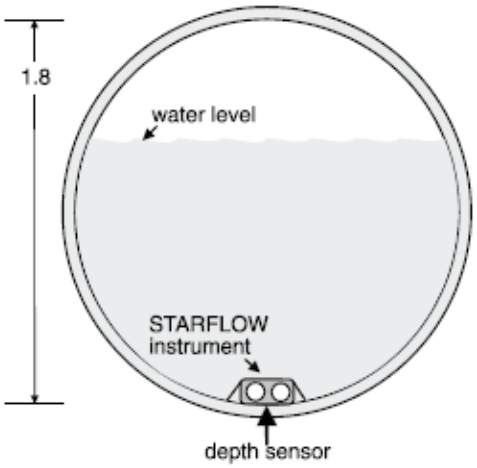
Define the smallest maximum depth for the channel that is compatible with your STARFLOW as this will give best results. (Example: For a 2m depth range STARFLOW in a 900mm diameter pipe choose 1 to improve accuracy.)

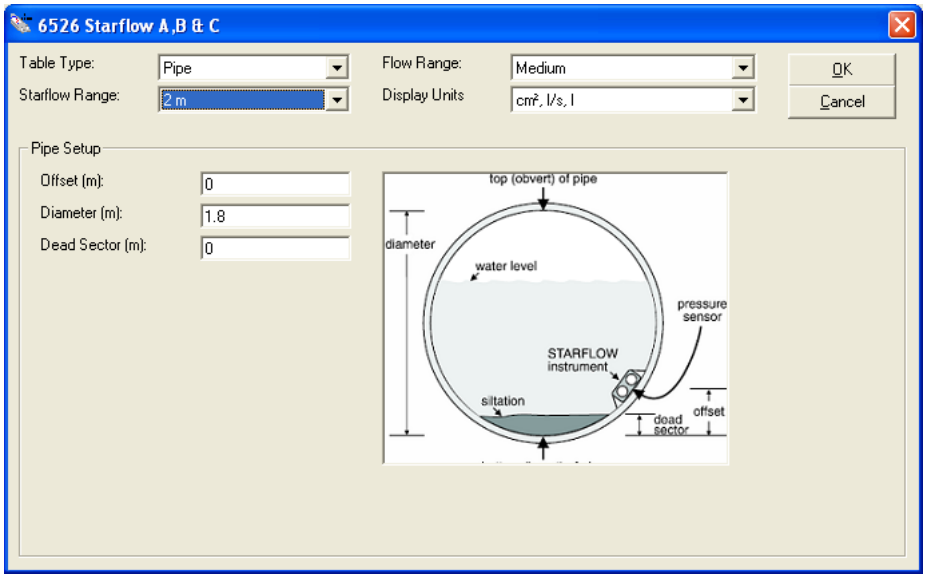
Offset (m)	This defines the offset from the bottom of the pipe to the position of the STARFLOW depth sensor. This is usually zero, however, in some installations the STARFLOW may be located away from the bottom (to avoid silt and rubbish).
Pipe Diameter (m)	Defines the pipe diameter.
Dead Sector (m)	The deadband due to siltation (if any).



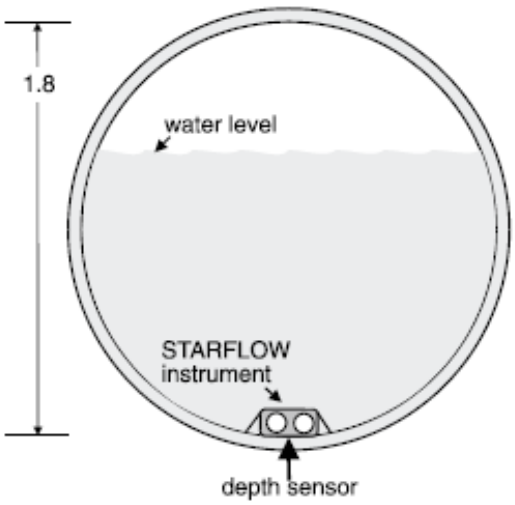
Pipe Examples

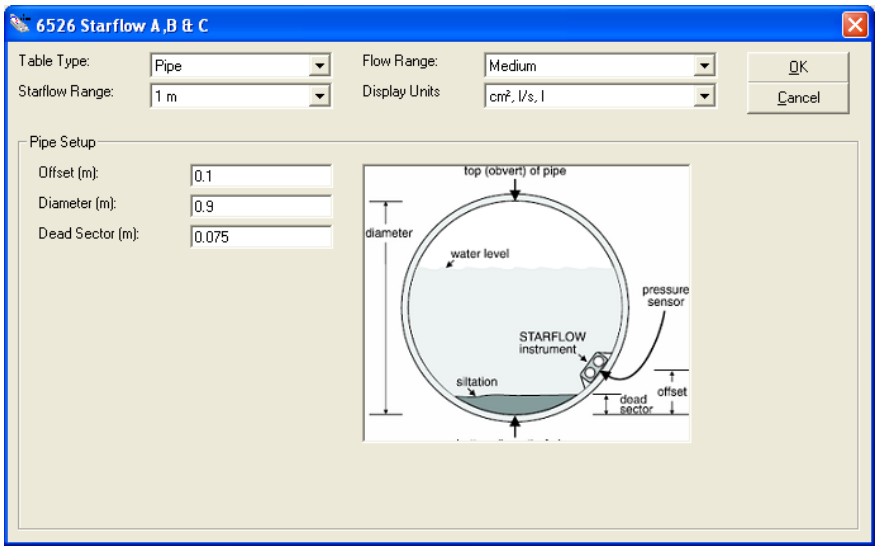
- **Pipe Example 1**
  Pipe is 1.8m in diameter. A STARFLOW unit is mounted at the bottom. No silt (dead sector) in pipe.





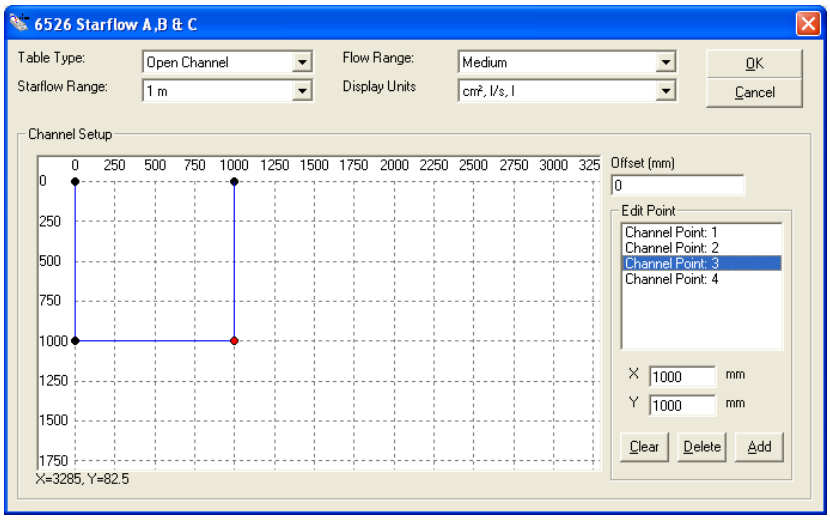
- **Pipe Example 2**
  Pipe is 900mm in diameter. A STARFLOW unit is mounted 100mm up from the bottom and there is 75mm of silt in the pipe. Note that the Table Range was set to 1 to give improved accuracy. Even though using a 2m depth STARFLOW, maximum depth in this application is 800mm (less than 1m).





12.3.1 Open Channel and Natural Stream

The dimensional definition of any open channel (or stream) consists of pairs of "distance" and "reduced level" measurement which define the profile of the channel or stream. These pairs comprise the Channel Cross-Sectional Area.



For constructed channels, this information is easily determined from known construction dimensions. For natural streams, you will need to make actual measurements of the stream bed.

In addition, you require two parameters, the depth range and offset.

Range (m) — Depth range of the channel. This defines the maximum depth of the channel. There are two ranges: 2m and 5m.
Define the smallest maximum depth for the channel that is compatible with your STARFLOW as this will give best results.
(Example: For a 2m depth range STARFLOW in a 900mm maximum depth channel, choose 1 to improve accuracy.)

Offset (m) — This defines the offset (reduced level) of the STARFLOW instrument from the reference to the depth sensor.

- **Determining Distance/Reduced Level Information**

Select an arbitrary reference point above the highest water level expected. This is (0,0) pair.

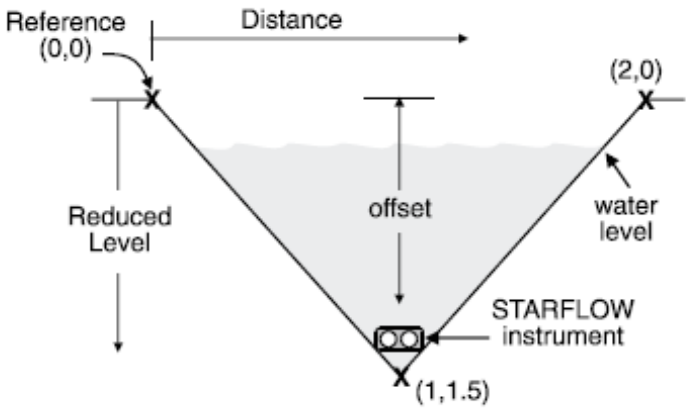
Measure across the channel and down to the channel bed at sufficient number of points to define the bed profile. Adjacent points are connected by straight lines. There may be as many Distance/RL pairs as you need.

The reference point (0,0) may be any datum standard which must be above the highest water level.

Open Channel and Natural Stream Examples

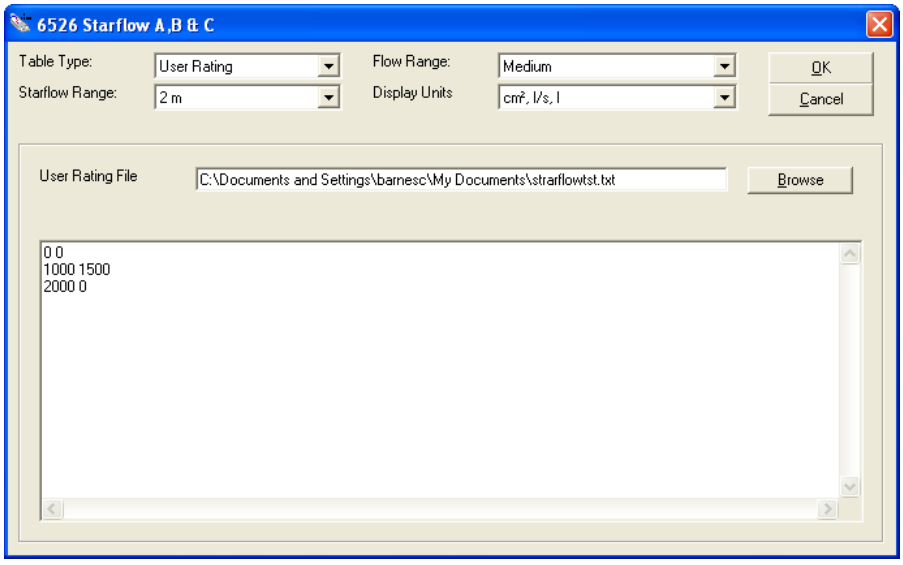
- **Open Channel Example 1:**

This Open Channel is a V-Notch shape which is 2m wide and 1.5m deep. A 2 metre depth range STARFLOW unit is mounted in the lowest point of the notch.



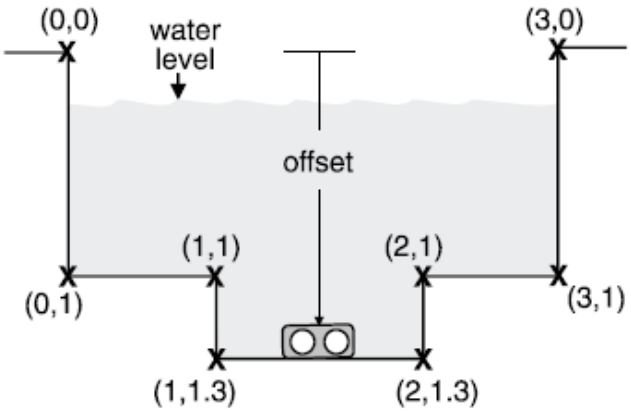
The Cross-Sectional Area File is shown below:
0 0
1000 1500
2000 0

The Area Rating Table window for this application looks like this:



- **Open Channel Example 2:**

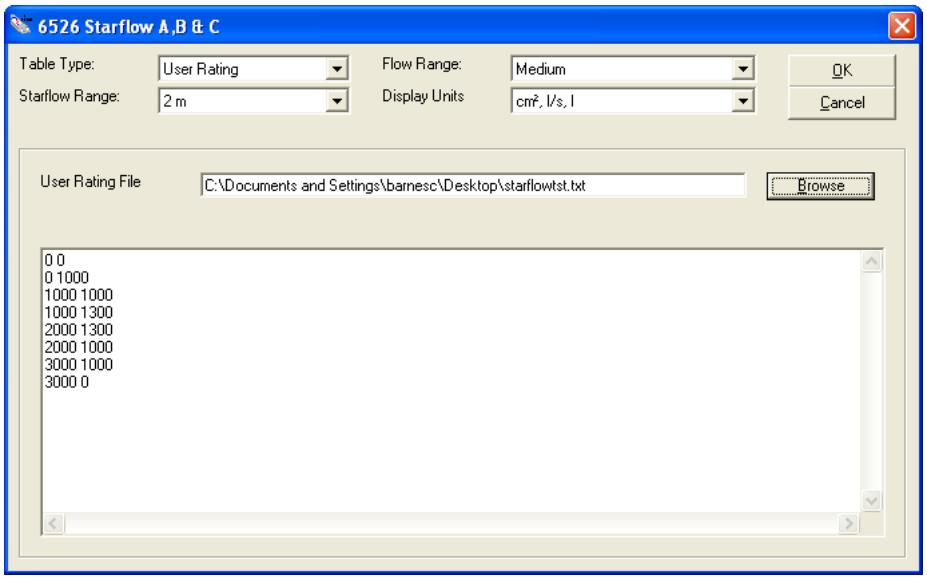
  This Open Channel is a pre-formed two-stage Rectangular Channel which is 3 metres wide and 1m deep with a 1m x 300mm secondary channel in the centre.



The Cross-Sectional Area File (OCEX2.XAC) is shown below:

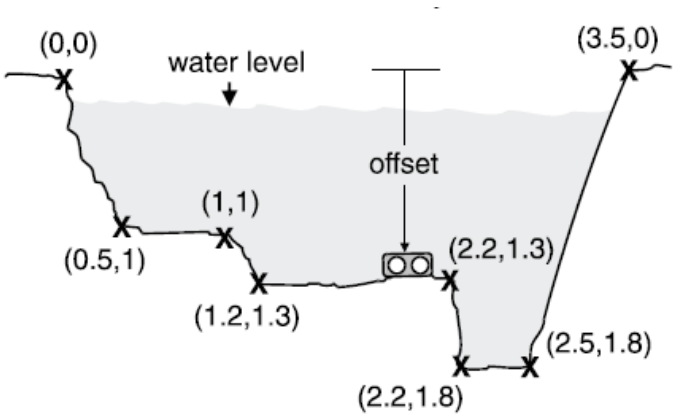
0 0
0 1000
1000 1000
1000 1300
2000 1300
2000 1000
3000 1000
3000 0

The Area Rating Table window for this application has these settings:



- **Open Channel/Natural Stream Example 3:**

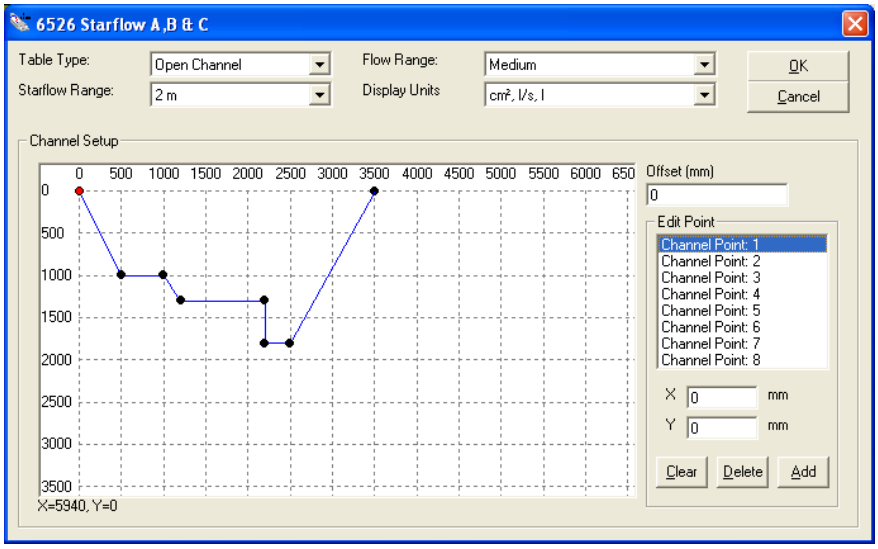
  This Natural Stream is 3 metres wide with the shape illustrated below.



The Cross-Sectional Area File is shown below:

0 0
500 1000
1000 1000
1200 1300
2200 1300
2200 1800
2500 1800
3500 0

The Area Rating Table window for this application looks like this:



12.3.2 Other Applications

If the channel you are measuring cannot be defined in the Cross-Sectional Area File (such as a partly filled ovoid pipe) you must supply your own Area Rating Table. This is called a User Area Rating Table.

This is only necessary if you cannot create a Cross-Sectional Area File. For most applications, the Area Rating Table is generated automatically from a Cross-Sectional Area File you create.

A User Area Rating Table is a text file with 1,000 entries spread evenly over the table range (as specified in the scheme) representing the cross-sectional area for each depth. For example, if the table range is 2m (2,000mm) then with 1,000 entries spread evenly, each entry is 2mm apart.

This table shows the depth for which each entry in the file represents an area:

Table Range	1m	2m	5m	10m
Entry 1	0mm	0mm	0mm	0mm
Entry 2	1mm	2mm	5mm	10mm
Entry 3	2mm	4mm	10mm	20mm
...	...	...	...	...
Entry 1000	999mm	1998mm	4995mm	9990mm

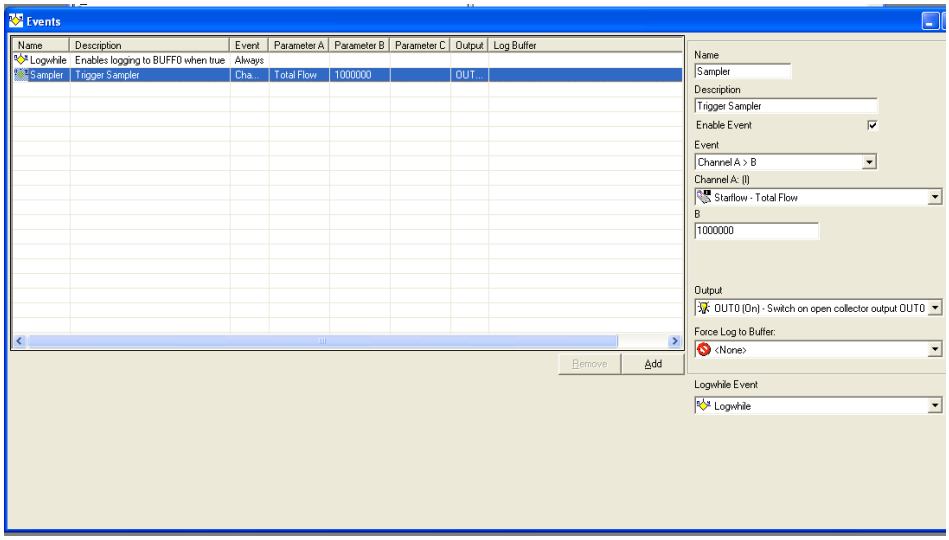
There is no special format for the file, only that each entry must be separated by whitespace (spaces, tabs or new lines) and that there are exactly 1,000 entries. The numbers must be positive (zero or greater) and may include a fractional part. The area values are in mm 2.

12.3.3 Selecting Channels to Log

You may now select whichever channels you wish to record. You may not select AVE values to record for Flow Rate, Flow and Total Flow channels as these are already processed and cannot be averaged.

12.3.4 Event Processing on Extended Channels

These channels may be used to trigger events. For example, you may wish to trip (switch on) a water sampler after every megalitre has flowed through the channel. Using the 6526-cm Flow Extension (which measures in litres), the Event definition in this example would look like this:



13.0 Computer Communication

The STARFLOW contains a MicroLogger which is similar in operation to other UNIDATA Data Loggers.

This section describes the detailed operation of this Data Logger and most users will not need to refer to this information. The Model 6301A STARFLOW Support Software provides all the necessary communication and programming requirements in an easy-to-use package (see section 5).

13.1 Communications (STARLOG) Protocol

The STARFLOW communicates using standard asynchronous, RS-232 serial communication standards which allow it to communicate with an IBM PC or compatible computer.

The communication format is:

- RS-232C compatible
- 300 to 76800 baud (9600 baud default)
- 8 data bits, 1 stop/start bit, no parity

You connect a computer to the STARFLOW via the 9-pin socket which is part of the Model 6603D cable. This allows you to load and unload schemes and data.

If the interface is connected, the STARFLOW sends a prompt to the interface (host computer). This prompt is an ASCII asterisk followed by a carriage return (* c/r).

The STARFLOW then waits 1 second for a request from the host computer. If no request is received the STARFLOW powers down (switches off). If a scan occurs during RS-232 communications then the measurement and reading will be processed.

13.2 Memory Layout

The STARFLOW uses its data CMOS memory for:

- Hardware Registers - Storage of housekeeping registers.
- Logger Program - Storage of user scheme definition.
- Buffer Control Table - Storage of pointers controlling Log Buffer.
- Log Buffer - End of logger program to end of memory for recording measured data

13.3 Hardware Register Information

The information contained in the header may be viewed in Test Mode or used by programmers wishing to write their own unload and analysis programs. The table below gives a description of each register numbered 0 to 255. For multiple byte registers the convention used is – least significant byte to most significant byte (LSB,MSB).

13.3.1 Model 6526, V4x.09 Memory Assignments

The STARFLOW, operating the standard instruction set, has the following fixed memory assignments in the Hardware Register:

Address	Size	Description
0	1	Software Revision Number (40 onwards)
1	2	Log Program runtime in milliseconds (16 bit integer)
3	1	Error flags (see Appendix A)
4	4	Scan counter (32 bit integer)
8	3	Reserved
11	2	msb of address (bits 8-23) used in LDBLK & MVBLK instructions
13	21	Reserved
24	2	Counter Channel C0
34	1	Arithmetic status register set by ADD, SUB, MUL, DIV instructions.
35	5	Reserved
40	2	Serial number (16 bit integer)
42	8	Reserved
48	—	Reserved for Log Program variables
200	2	Water Depth (in mm)
202	2	Water Temperature (in .01 °C)
204	2	Battery Voltage (in .01V)
206	2	Water Velocity (in mm/sec)
208	8	Reserved
216	2	Doppler Shift (Hz) A8 - Frequency
218	2	Distribution Quartile (%) A9 - Quartile
220	2	Number of Samples (#) A10 - Samples
256	128	Buffer Control Tables A11 - Signal
384	—	Log Program

13.4 STARFLOW - Instructions

The STARFLOW instrument incorporates a STARLOG compatible MicroLogger which is a data recording unit programmed using a computer. Its program resides in the first part of the logger's main memory (after the Hardware Registers and Buffer Control Table). It is defined by a user and loaded into logger memory from the host computer.

The logger program is executed every logger scan (from 15 sec. to 5 min.). The first instruction in the logger program is at Address 384. The Data Logger executes this program until an EXIT instruction is encountered (opcode = 0).

13.4.1 STARFLOW - Operation Sequence

Every scan, the STARFLOW performs the following sequence:

1 Measure velocity, depth, temperature and battery and store their values in the Hardware Register area (from Address 200 on).

2 Execute the logger program (until EXIT detected).

3 If an RS-232 connection is sensed, send * c/r prompt to Computer Port and wait for a response.

4 Shut down STARFLOW and await next scan time.

13.4.2 STARFLOW - Program Instructions

A logger program starts at Address 384 and consists of one or more instructions. Each instruction is four bytes long (even though some instruction do not use all four bytes). An instruction takes about 0.5 millisecond to interpret and execute.

Typical instructions include:

TIMED GOTO	Timer controlled logging sequences
CONDITIONAL GOTO	Event controlled logging sequences
LOG DATA	Flexible data storage command
(BLOCK) MOVE	Block, Word and Byte move
ACCUMULATE	Block summation for averaging
OUTPUT	Control output sequences
BLOCK CLEAR	Storage initialization
ADDITION	2 & 4 byte operands, 4 byte result
SUBTRACTION	2 & 4 byte operands, 4 byte result
MULTIPLICATION	2 & 4 byte operands, 4 byte result
DIVISION	2 & 4 byte operands, 4 byte result or 2 byte result & remainder
SERIAL INPUT/OUTPUT	Bi-directional Data Bus read/write

14.0 Appendix A – Installation Checklist

14.1 Installation Steps

14.1.1 Installing The STARFLOW Instrument

Do the following:

1 Locate the STARFLOW in such a way to avoid accumulating debris, being buried by alluvial material or getting washed away.

2 Ensure that you have enough cable to reach the power supply and keep the vent tube dry.

3 Set-up a weatherproof enclosure for the battery, drying tube and computer/MODEM connectors. Ensure that this enclosure is open to the atmosphere.

4 Connect a 12V battery to the signal cable.

15.0 Appendix B - STARFLOW SDI-12 Interface

15.1 Introduction

SDI-12 is an industry-originated, serial digital interface bus designed to allow an operator to connect a wide variety of transducers (meteorological, hydrological, water quality, etc.) to a single SDI-12 Data Recorder, such as a STARLOGGER, with a single cable bus. This means that you could, for instance, connect several STARFLOW instruments along with the other SDI-12 sensors to another STARFLOW instrument or a STARLOGGER (or another brand SDI-12 Data Recorder) and not have to worry about combinations of RS-232, parallel analog, BCD, serial analog, RS-422, etc. signal types.

A unique feature of STARFLOW is its ability to operate as an SDI-12 sensor or configure the STARFLOW's MicroLogger to be an SDI-12 Data Recorder.

This appendix assumes that the reader is familiar with the operation of the SDI-12 Sensor (Sensor) and the SDI-12 Data Recorder (the Recorder).

15.2 Using STARFLOW As An SDI-12 Sensor

To use the STARFLOW as an SDI-12 Sensor, you must first set its SDI-12 Configuration using the advanced settings TAB).

Select SDI SENSOR and adjust any SDI-12 configuration such as SDI-12 Address and Channels to report.

The STARFLOW will continue to operate at its pre-set scan rate and will perform all the normal logging functions. STARFLOW measurements, RS-232 communications and data logging, co-exist with SDI-12 interrogation.

Whenever an SDI-12 Data Recorder issues a START MEASUREMENT/SEND DATA sequence, STARFLOW immediately responds with the latest parameter readings.

In this mode, the SDI-12 command START MEASUREMENT does not initiate a new measurement cycle and the data is always valid and available for immediate retrieval by the Data Recorder.

15.2.1 Theory of Operation

When the Data Recorder sends a "break signal", the STARFLOW wakens and captures the SDI-12 command following the break signal. If the command is valid, the STARFLOW reads its address setting to see whether or not its address is in fact being called, or if the address of some other device (at another location) is being sought. If the Data Recorder is looking for a different address, the STARFLOW will go back to sleep until another break signal is received.

If the address being sent belongs to the STARFLOW, it will scan the instructions coming from the Data Recorder to see what action is required.

The two most important commands at this time are:

Measure: If the STARFLOW receives the START MEASUREMENT command, it will report back to the Data Recorder the number of parameters enabled for measurement, and that these parameters are available to be sent to the Data Recorder immediately.

Data: If the STARFLOW receives the SEND DATA command, it will send the last parameter readings measured to the Data Recorder for storage.

15.2.2 Data Reported by STARFLOW Sensor

STARFLOW will respond to an SDI-12 interrogation with up to five parameters. Each parameter represents a STARFLOW 16-bit integer channel value (e.g., Water Velocity). The parameter is reported as a five (5) digit fixed point, signed integer.

For example:

2100 means 2100mm/s positive flow
-350 means 350mm/s reverse flow

The implied parameter scaling is the same as defined for STARFLOW channels:

Velocity	mm/s
Depth	mm
Temperature	.01°C
Voltage	.01V

To operate as a Sensor, the STARFLOW does not have to be reprogrammed with a Scheme although it may be desirable to have the STARFLOW operating as a backup recorder.

15.2.3 Reporting Computed Flow Results

When STARFLOW is programmed with a flow computation scheme additional flow extension channels are available for reporting. These are:

Address	**Type**	**Meaning**
160	16 bit integer	Cross Sectional Area
162	32 bit integer	Flow Rate
166	32 bit integer	Flow
170	32 bit integer	Total Flow

- Limitations within SDI-12 do not allow 32 bit integer values to be reported without loss of resolution. Further limitations may occur in the SDI-12 Recorder's ability to process large numbers. It is recommended that 32 bit channels be reported as 2 x 16 bit integer values (e.g. Flow Rate addr 162 scaled mm/s, addr 164 scale 65536 mm/s).

15.3 STARFLOW SDI-12 Implementation Notes

The following technical information describes STARFLOW's implementation of the SDI-12 standard.

15.3.1 SDI-12 Data Recorder Commands

Two Scheme Program instructions are used to control the SDI-12 Recorder operation:

SDIGET which collects measurements from the nominated SDI-12 sensor, and

SDICONV which converts the collected data for use by the Log Program.

Measurements may be converted into fixed point Short Integers (for manipulation by the Scheme), Floating Point Numbers (for logging by the Scheme) or an ASCII string.

- Integers are two bytes.
- Floating Point numbers are 4 bytes.
- An ASCII string is zero byte terminated.

15.3.2 Data Recorder Coordination

Once an SDI-12 communication has commenced (SDIGET instruction executed) the SDI-12 Bus is busy and will ignore any subsequent SDIGET commands until the active measurement transfer is complete. The measurements are stored in memory, to be converted by a SDICONV instruction.. Converted measurements (stored on MicroLogger channels) may be further processed by the Scheme program and Logged.

Because most SDI-12 sensors (unlike the STARFLOW Sensor) require considerable time to make their measurements (typically 60 seconds), the STARFLOW Data Recorder remains powered up awaiting a response from the sensor. This mode of operation usually requires the Scheme Program to initiate SDI-12 Measurements (SDIGETs) two scans prior to the desired Log Interval.

The sequencing of the SDI-12 measurements is under the control of the Scheme Program (which is defined during Scheme Editing, see *Using the Scheme Editor* on page 66).

15.3.3 Measurement Errors

If during a data collection sequence (SDIGET) an error occurs, the sequence is retried a total of ten times (by default). A non-recoverable error causes the SDIGET instruction to report a "null" result and a subsequent SDICONV will not return any data (the channel readings remain unchanged from their last good reading).

15.3.4 STARFLOW SDI-12 Command Implementation

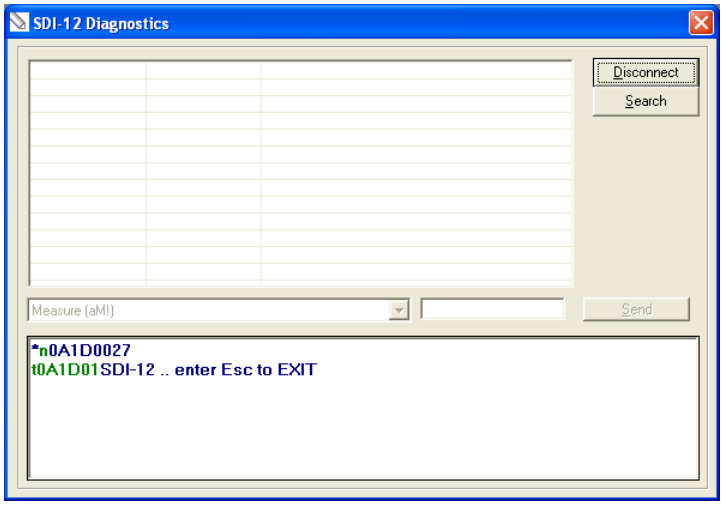
The following table shows which SDI-12 commands are and are not recognised:

Command	Description	Sensor	Data Recorder
a!	acknowledge	✓	×
aI!	send identification	✓	×
aV!	start verification	✓	×
aM!	start measurement	✓	✓
aD0!	send data	✓	×
aM1...9!	start additional Measurement	×	✓
aD1...9!	send additional Data	×	×
extended commands		×	✓

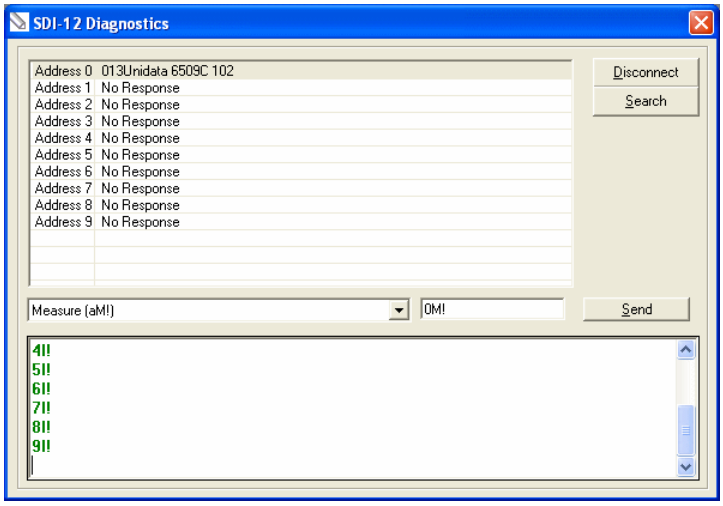
15.4 SDI-12 Test

The `SDI-12 Test` function allows you to check the operation of the data logger as an SDI-12 recorder and the operation of any SDI-12 sensors connected to it. You are able to issue identify, measurement, and read commands.

When the window is first opened, click `Connect` to connect to the data logger and start SDI-12 diagnostics:

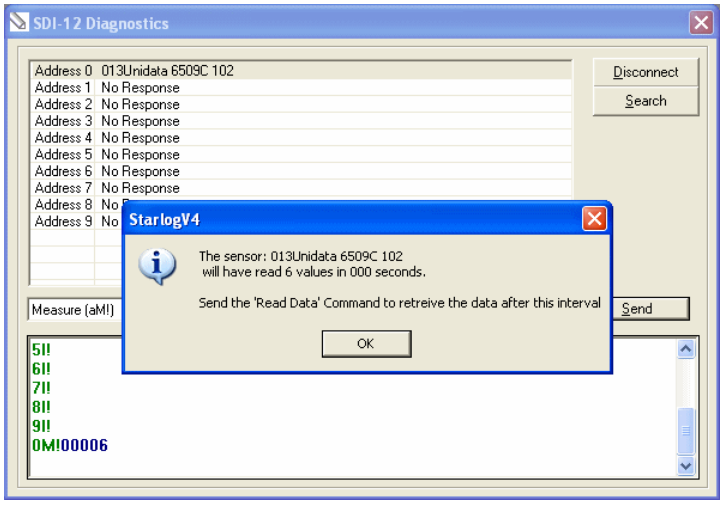


Next, click `Search` to send identification requests to the first ten sensors. The window will list any sensors found:

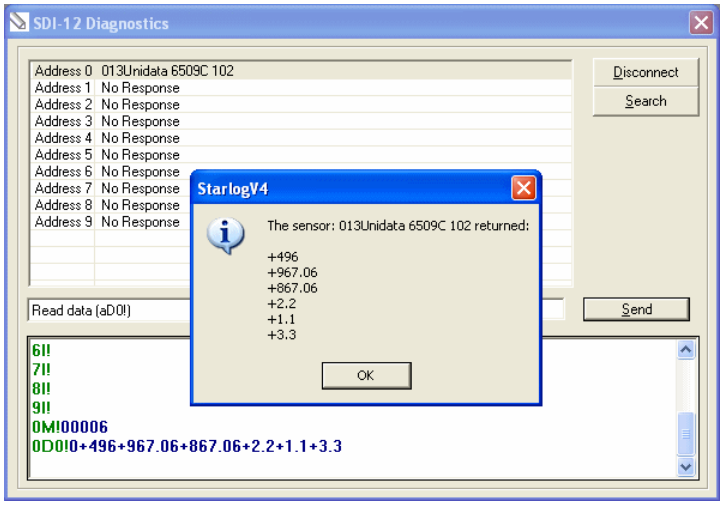


The above screenshot shows that there is a Unidata 6509C Water Level instrument, connected on address 0, and no other instruments on any other channel if using a Starflow it would appear with 6526.

To send commands to a sensor, select it from the list, then select the command to send from the drop-down list (the “Measure (aM!)” in the above screenshot). When you select a command, the actually command that will be sent on the SDI-12 bus is shown next to it (the “0M!” in the above screenshot). Click `Send` to send the command on to the SDI-12 bus.



If there is a response, it will appear in the communication log area, and the software will also provide an interpretation of the response. The above shows the response to a Measure command, the following is the response to a subsequent Read:



Note that different sensors will return not just different values, but different numbers of values. Most sensors will only return a single value.

16.0 Appendix G - Model 6705 – Expanding Band Kit

The Model 6705 Expanding Band kit allows you to install a STARFLOW instrument into a pipe.

Features

Modular – The design is modular, allowing it to fit into any size pipe. The band is flexible enough to fit irregular shapes, such as ovoid (egg shaped) sections.

Robust – All components are made from stainless steel and the band fittings are 100mm wide to fit the standard STARFLOW mount.

Adjustable – Although pipes come in standard diameters, their dimensions are not always accurate. This means that an expanding band system must allow the installer to make adjustments on site. To achieve this, the Model 6705 system is made so that general assembly can be done in the workshop, whilst adjustments can be made in the field with hand tools. An expanding turn-buckle locks the band into the pipe.

16.1 MODEL 6705 Components

The Model 6705 Expanding Band kit consists of the following parts:

Model	Description
6705A	**Small Expanding Clamp** Stainless Steel expanding turn-buckle and band clips. 100mm wide. 100mm long, 50mm expansion. Use in pipes up to 600mm (24") dia
6705B	**Large Expanding Clamp** Stainless Steel expanding turn-buckle and band clips. 100mm wide. 150mm long, 100mm expansion. Use in pipes over 600mm (24") dia
6705D	**1800mm Band Segment** 100mm wide, 0.6mm S/Steel band with 50mm spaced locating holes at both ends for "pop rivets"
6705F	**50mm Band Joiner** 100mm wide, 50mm long S/Steel joiner with 50mm spaced locating holes.

16.1.1 Band size selection

To determine what components are needed for a STARFLOW pipe installation, you need to know the pipe diameter.

Pipe dia	Clamp	Bands	Joiners
Up to 600mm	6705A	6705D	-
600-1200mm	6705B	2 x 6705D	1
1200-1800mm	6705B	3 x 6705D	2

- Pipes less than 300mm diameter are NOT RECOMMENDED FOR STARFLOW INSTALLATION due to instrument's size.

16.2 Installation

To prepare and install the STARFLOW into a pipe, you need:

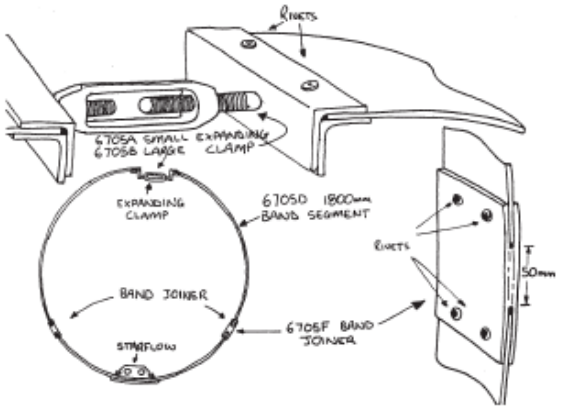
- 6705 Expanding Band kit.
- Electric drill.
- Hand "pop rivet" tool.
- Medium size adjustable spanner.
- Heavy duty metal shears.
- Measuring tape.

Do the following:

1 Arrange clamp, band(s) and joiner(s) so that STARFLOW unit will be positioned at the bottom (invert) of the pipe and an Expanding Clamp at the top (obvert) of pipe (see diagram).

2 Drill 2 x 5mm holes, 93mm spaced in the centre of the band to locate the STARFLOW instrument (see diagram next page). (Use the STARFLOW mounting clamp as a guide).

Use a small pilot drill bit (about 2mm) then finish with the 5mm bit. (When drilling stainless steel, DO NOT stop once drilling has begun, as this will immediately blunt the drill bit.)



3 “Pop rivet” the band sections together (if required) and “pop rivet” the end of one band to the Expanding Clamp (see diagram). Note: if a “pop rivet” tool is not available, use M3 x 6mm stainless steel self tapping screws (screwed inner to outer).

4 If the inside circumference of the pipe is ACCURATELY known, then cut the band assembly to this length LESS 25mm for fitting clearance. (Circumference = Diameter x 22/7)

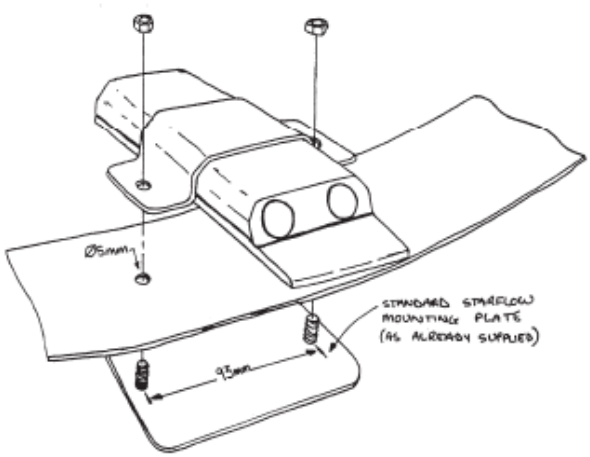
- Note: the band length must be measured to include the Expanding Clamp (fully closed), bands and joiners all together as shown.
- Note: if you are unsure of the pipe dimensions, make the final measurement on site and cut the band assemble to suit the pipe.

Position and tighten STARFLOW and band, then:

1 Bolt the STARFLOW mount to the band (if desired, also mount the STARFLOW instrument).

2 Fold the band into a circle to easily fit inside the pipe.

3 Position into place inside the pipe.



4 Slip the loose end of the band into the expanding clamp.

5 Adjust clamp until band is tight inside pipe (use spanner if necessary).

6 Slip STARFLOW unit into mount and tighten.

- Security: A padlock may be placed through the centre of the turn-buckle to prevent the band (and STARFLOW instrument) being removed.